

STREET CONSTRUCTION
INSPECTOR'S MANUAL



CITY OF PORTLAND

**OFFICE OF
TRANSPORTATION
ENGINEERING & DEVELOPMENT**

CONSTRUCTION INSPECTION SECTION

TABLE OF CONTENTS

Section	Page
SECTION 1 - INTRODUCTION	
Purpose of the Manual	1
Terminology/Definitions	1
Organization of the Manual	2
SECTION 2 - THE STREET CONSTRUCTION INSPECTOR:	
Purpose	5
General Responsibilities	5
Authority and Limitations	7
Information/Notification Procedures	8
Manager/Field Supervisor	8
Contract Manager	9
Contractor's Authorized Representative	9
Relationship with other Participants	9
SECTION 3 - TYPE OF PROJECTS	
Contract Improvements	12
Local Improvement District Projects	12
Oregon Department of Transportation (ODOT) Projects	13
Oregon Department of Transportation (ODOT) Certified Projects	14
Permit Improvements	15
Differences in Inspection Procedures Between Contract and Permit Improvements	16
SECTION 4 - COORDINATION WITH OTHERS	
Manager and Field Supervisor	19
Project Manager (Construction Manager OR Review Engineer)	
Utilities	20
Coordination	20
Sewer and Water Construction and Inspection	20
Other Utilities Inspection	20
Survey Staking	20
Materials Testing Laboratory	20
Traffic Signs, Signals, and Pavement Markings	21
Traffic Signs and Pavement Markings	21
Traffic Signals	21
Street Lighting	22
Street Name Signs	23
Maintenance Items	23
Private Surveyors, Engineers, and Testing Laboratories	23
Contractors	23
Property Owners and the General Public	25
SECTION 5 - OVERVIEW OF DUTIES AND PROCEDURES	
General Policies and Procedures	29
Inspection Schedule	29

Project Workscope and Schedule	30
--------------------------------------	----

TABLE OF CONTENTS

Section	Page
Preconstruction - Inspection checklist.....	31
Utility Work - Inspection Checklist	32
Traffic Signals	33
Street Lighting.....	33
Traffic Signs, Street Name Signs, & Pavement Markings.....	33
Materials Sampling and Testing - Inspection Checklist	34
Sub-grade Preparation	34
Drainage	34
Aggregate Base Course Construction.....	34
Concrete	34
Asphalt Paving	35
Subgrade Construction - Inspection Checklist	35
Drainage Construction - Inspection Checklist.....	36
Aggregates Base Construction - Inspection Checklist.....	36
Concrete Construction - Inspection Checklist	36
Pavement Construction - Inspection Checklist	37
Project Close Out - Inspection Checklist.....	38
Documentation - Inspection Checklist	38
Ongoing Responsibilities - Inspection Checklist	39
Two-Year Warranty Checks	39

SECTION 6 - PRECONSTRUCTION

Field Check.....	43
Construction Documents.....	44
Project Review	44
Jobsite Inspection and Documentation	45
Video Documentation	45
Photographic Documentation	46
Preconstruction Meeting.....	46
Property Owner Notification	46
Construction Authorization	47
Field Changes.....	47
Other Information.....	47
Survey Staking	49
Project Review With The Contractor	51
Salvage And Historic Preservation	51
Horse Rings	51
Belgian Paving Blocks	51
Historic Concrete Stamps.....	52

SECTION 7 - UTILITIES

Utility Permits/Coordination	57
Utilities Inspection	58
Sewer.....	58
Water	58

Other Utilities	59
-----------------------	----

TABLE OF CONTENTS

Section	Page
Additional Information About Utilities Work.....	59
Utility Conflicts and Damages	60
Reporting Utility Conflicts.....	60
Reporting Utility Damages.....	60
Other Suggestions.....	61
Utility Cuts on State Highways	61
 SECTION 8 - MATERIALS SAMPLING AND TESTING	
General Guidelines.....	68
Testing Frequency	69
Notification of Test Results	69
Continuing Inspection	70
Mass Grading and Fills	70
Subgrade Preparation	71
Drainage	71
Aggregate Base Construction	72
Concrete	73
Approved Concrete Mixtures.....	73
Slump & Air Tests	73
Cylinder Tests.....	74
Asphalt Paving.....	75
Approved Hot Mixed Asphalt Concrete (HMAC) Mixtures	75
Asphalt Samples for Extraction and Rice	75
Asphalt Paving Density.....	76
 SECTION 9 - SUBGRADE PREPARATION	
General.....	83
Site Examination before Subgrade Preparation	83
Survey Staking and Control.....	84
Subgrade Construction	84
Clearing and Grubbing Operations.....	84
Visual Inspection after Clearing and Grubbing	85
Mass Grading and Fills.....	85
Earthwork	86
Excavation	86
Embankment.....	87
Compaction.....	87
Materials Sampling and Testing.....	88
Ongoing Inspection.....	89
Subgrade Stabilization.....	89
Foundation Stabilization	89
Soil Stabilization.....	89
Geosynthetic Fabrics	90
Erosion Control.....	90
Subgrade Preparation Inspector's Checklist.....	92

TABLE OF CONTENTS

Section	Page
SECTION 10 - DRAINAGE	
General.....	99
Materials Sampling and Testing.....	99
Materials Used in Drainage Systems.....	99
Pipe.....	99
Drainage Structures.....	100
Storm Drainage Construction.....	101
Inlet Structures.....	101
Trench Excavation.....	101
Subdrains.....	102
Laying Pipe.....	102
Backfill and Compaction.....	103
Sump Construction.....	103
Swale/ Water Quality Planter.....	104
Drainage: Inspector's Checklist.....	105
SECTION 11 - BASE CONSTRUCTION	
General.....	113
Materials Sampling and Testing.....	113
Base Material.....	113
Untreated Roadway Base.....	113
Treated Roadway Base.....	114
Base Construction.....	114
Inspection before Placing Base Material.....	114
Line and Grade.....	114
Spreading of Base Material.....	115
Compaction.....	115
Weather Limitations.....	116
Base Construction: Inspector's Checklist.....	117
SECTION 12 - CONCRETE	
General.....	120
Materials Sampling and Testing.....	120
Components of Concrete.....	120
Portland Cement.....	120
Admixtures.....	121
Concrete Strength.....	122
Materials Used in Concrete Construction.....	123
Curing Compounds.....	123
Joint Material.....	123
Mortar.....	123
Grout.....	124
Membrane Waterproofing Materials.....	124
Concrete Reinforcing.....	124
Concrete Formwork.....	125
Working with Concrete.....	126

TABLE OF CONTENTS

Section	Page
Weather Conditions	126
Transporting, Handling, and Placing	127
Joints.....	128
Concrete Placement and Finishing	128
Curing and Protection.....	130
Concrete Construction	131
Test Section Installation	131
Preservation of Horse Rings, Historic Dates and Names in Concrete	132
Plain Concrete Pavement.....	132
Curbs and Gutters	133
Sidewalks, Driveways, and Handicap Ramps.....	136
Concrete Walls	137
Concrete: Inspector's Checklist.....	139
Preparation	139
Concrete Placing and Finishing.....	140
Concrete Paving	140
Curb and Gutter Construction	141
Sidewalk, Driveway, and Ramp Construction	142
Wheelchair Ramp Checklist	143
 SECTION 13 - ASPHALT PAVING	
General.....	148
Materials Sampling and Testing.....	148
Hot Mixed Asphaltic Concrete (HMAC)	148
Paving Mix Design and Characteristics.....	149
Asphaltic Paving Construction	149
Inspection before Paving Operations	149
Line and Grade	150
Underground Utilities	150
Tack Coat	150
Weather Conditions	151
Transport and Delivery	151
Paving Machines	152
Hand Spreading.....	153
Lift Thickness.....	153
Joints.....	153
Compaction.....	154
Temperature	154
Contact Pressure	155
Compaction Equipment and Coverage	156
Roller Operation and Procedures.....	156
Pavement Failures and Troubleshooting	157
Hot Mix Asphalt Paving: Inspector's Checklist.....	159
Preparation	159
Spreading	159
Rollers and Compaction	160

TABLE OF CONTENTS

Section	Page
SECTION 14 - PROJECT CLOSEOUT	
Final Inspection and Punch List	165
Cleanup and Restoration.....	165
Final Inspection.....	165
Punch List	166
Final Punch List Inspection	167
As-Built Drawings.....	167
Other Project Closeout Requirements	168
SECTION 15 - DOCUMENTATION	
Daily Progress Report	171
Types of Information to Include in the Daily Progress Report.....	172
Bi-Monthly Payment Estimates.....	173
Logging and Filing Photographs and Videos	174
Other Documentation	174
APPENDIX A - INSPECTOR'S EQUIPMENT	187
APPENDIX B - NOISE	188
APPENDIX C - SAFETY, ACCESS, AND TRAFFIC CONTROL.....	189
APPENDIX D - LANDSCAPING AND TREES.....	192
APPENDIX E - EMPLOYEE PROCEDURES.....	197
APPENDIX F - COMMONLY ASKED QUESTIONS.....	199
GLOSSARY	201

SECTION 1 - INTRODUCTION

PURPOSE OF THE MANUAL

This manual describes the duties and procedures required of street construction Inspectors in the City of Portland's PBOT/CON section. It is intended to serve as both a training tool for new Inspectors and a useful reference and reminder for experienced Inspectors.

The manual describes the tasks that are performed by the Inspector, the procedures that should be followed, and the policies governing this work. It provides related background information (for example, the responsibilities of other City bureaus) that helps put the Inspector's job in context. Some technical information is also provided about certain materials and construction methods.

The manual is **not** intended to be an exhaustive textbook on construction and inspection. It assumes a certain level of technical knowledge and a familiarity with the Standard Construction Specifications. It is also essential for the Inspector to have a thorough understanding of the special specifications for each project.

The Inspector should recognize that each inspection job will involve different circumstances and requirements. While the manual can provide general guidelines, the Inspector must also exercise judgment and flexibility in dealing with specific situations. Part of the manual's purpose is to help identify when and where to get assistance if it is needed.

TERMINOLOGY/DEFINITIONS

Inspectors provide street inspection services for construction work performed in the public right-of-way. They are part of the Construction Inspection Section in PBOT.

As explained later in Section 3, the Construction Inspection Section is responsible for inspecting multiple types of improvements. This manual covers inspection for contract and permitted improvements only and does not address inspection for permits inspected by the Street Systems Management (SSM) Section.

The Inspector interacts with a number of other project participants in Engineering Technical Services, as well as other City bureaus. More information about the various project participants is provided in Section 4.

The main terms used in this manual are **bolded** in the text for easy reference and are briefly defined below. Other terminology is defined in the Glossary.

- **Inspector:** The street construction Inspector in Construction Inspection Section. (Other types of inspectors involved in a project are defined in the text and are not capitalized.).
- **Manager:** The Section Manager of the Construction Inspection Section. They manage the inspectors on all the street construction projects to ensure they are built to the project plans and specifications.
- **Field Supervisor:** The Manager's "eyes and ears" in the field. They monitor all inspection projects and keep the Manager informed of their progress. The Field Supervisor trains new Inspectors and should be the Inspector's first contact for questions or problems (unless otherwise indicated in the manual).
- **Project Manager:** The Project Manager is responsible for the budget, inter-agency agreements, project scope, and permitting aspects of a Contract project.
- **Contract Manager:** The Contract Manager works with the Inspector and the contractor to administer the work on Contract projects.
- **Review Engineer:** The Review Engineer works with the developer/permittee and the Inspector during the construction of Permit projects.
- **Office:** The Construction Inspection Section office.
- **Contractor:** The person or organization responsible for performing the work and identified as such in the construction documents.
- **Technician:** The person that processes the paperwork on contract projects including pay notes, FIR's, CMO's, etc. This person can also answer questions related to the process to get paperwork completed correctly.

ORGANIZATION OF THE MANUAL

Section 2: the Street Construction Inspector: An Overview provides an overview of the Inspector's general responsibilities and authority, including appropriate lines of communication.

Section 3: Types of Project, defines the different types of improvement projects and identifies differences in inspection procedures among them.

Section 4: Coordination with Others, describes the other participants involved in construction projects and how the Inspector coordinates with them.

Section 5: Overview of Duties and Procedures outlines typical inspection tasks from

project assignment through project closeout. It is intended as an overall summary for quick review and reference.

Sections 6 through 15 describe the Inspector's duties in more detail. Sections 9 through 13 also provide some technical background information about materials and construction methods. Detailed checklists of inspection tasks are provided at the end of those five sections. While all of these tasks may not be applicable to a given project, the Inspector should review the checklists to refresh his memory and ensure that all necessary steps have been performed.

The **Appendices** contains supplementary information of interest to the Inspector.

Relevant References identifies other reference sources that may be useful to the Inspector.

The **Glossary** and **Index** are provided to facilitate use of the manual.

The City of Portland's Standard Construction Specifications govern and provide additional information about some of the policies and procedures discussed in this manual. Where applicable, the section number of the Standard Construction Specifications is shown in a box next to the relevant text.

This is an example of a reference to the Standard Construction Specifications:

Some subjects are discussed briefly in one section of the manual, but covered in more detail elsewhere. In these cases, a box next to the relevant text shows the section where more information is provided.

00110.10

This is an example of a reference to another section of the manual.

See
Section 1

END OF SECTION 1

NOTES

SECTION 2 - THE STREET CONSTRUCTION INSPECTOR: AN OVERVIEW

PURPOSE

The purpose of the street construction Inspector is to inspect street improvement projects constructed in the public right-of-way (R.O.W.). The Inspector is the bureau's on-site representative who is empowered to enforce the provisions of the contract or permit governing the work.

The Inspector's primary duty is to verify that construction work is in compliance with all plans, specifications, permits and other relevant regulations and requirements. They are responsible for observing all phases of the work, including sampling and testing, to monitor the quality of workmanship and report the progress to the Contract Manager or Permit construction manager. They are a vital link between the design of a project and its execution in the field.

Good inspection can be worth many times its cost in preventing errors and omissions of construction that might result in costly tear out, replacement, or re-doing the work. The Inspector performs an essential service to the many parties that may be involved in each project: the City, developer, property owner, Contractor, and public. The proper execution of their job provides that:

The owner gets the designed project he is paying for.

The City's responsibilities and requirements are fulfilled, and the City is protected against claims, delays, and cost overruns.

The job is performed safely and with minimum disturbance to property owners and the general public.

Inspection is not an easy job. It requires conscientious people who are trained and knowledgeable of construction processes and materials, and skilled in working with the public, Contractors, and associates. The Inspector performs an essential and valued role for the Bureau.

GENERAL RESPONSIBILITIES

The Inspector's duties are outlined in Section 5, with detailed descriptions provided in subsequent sections of the manual. In general, the responsibilities are to:

00150.02

- Be familiar with the construction documents and verify compliance with them.

- Be generally familiar with and have access to relevant standards, codes, and ordinances, and verify adherence to them.
- Coordinate and communicate with the various parties involved with the work.
- Ask the Contractor about upcoming work and the methods and procedures he plans to use.
- Monitor materials. Verify that sampling and testing is being done, as well as material certification and that documentation requirements are being met.
- Conduct onsite inspection of the work in progress to verify proper construction methods and workmanship.
- Document all significant activities and events daily.
- Observe actual progress in comparison with estimated progress. Keep ahead of the work in order to anticipate conditions or conflicts that may cause a delay in completion.
- Report the progress of the work and any of the work that is satisfactorily completed and eligible for payment.
- Interpret the intent of the construction documents, if asked by the Contractor, to the best of his ability. When in doubt, ask the Field Supervisor or Construction Manager/Review Engineer for assistance.
- Advise as to appropriate work methods and procedures, if asked by the Contractor.
- Resolve conflicts quickly; if they cannot be resolved, contact the Field Supervisor or Construction Manager/Review Engineer immediately.
- Reject materials and workmanship not in conformity with the contract or permit requirements; notify the Contractor at the time or at the first opportunity of unsatisfactory work or materials. Do not give the Contractor the false impression that faulty work is acceptable by failing to point it out.
- Advise the Field Supervisor or Construction Manager/Review Engineer of any deficiencies, improper work methods, or safety hazards that the Contractor does not promptly correct.
- Be able to affirm that the project conforms to the construction documents at the completion of the work.

In summary, the Inspector must observe carefully, anticipate and recognize problem areas, exercise judgment, take action, and make decisions literally hundreds of times during the course of a project.

AUTHORITY AND LIMITATIONS

Inspection is one part of a total construction process that involves a number of activities and participants, from project design through final approval. It is important for the Inspector to remember the limits of his authority and the roles of the other participants.

The Inspector **may not**:

00150.02(c)

- Issue directives to the Contractor relative to any aspect of construction means, methods, techniques, sequences, or procedures. The Inspector may advise the Contractor if asked, but may not issue orders. Particular care should be taken that no instructions are given that could be construed as assuming superintendence of the work. Poor judgments in this respect could result in claims against the City.
- Interfere with the work performed by the Contractor or assume any responsibility for the performance of his work. Construction of the project is the Contractor's responsibility.
- Authorize any significant deviations from the contract documents or permit improvements without prior approval from the Construction Manager.
- Authorize additional work. This is the responsibility of Construction Manager. The Construction Manager must also approve in advance any expenditure not specified on the plans or within the estimate for Contract Projects. This is done with a Contract Change Order (CCO).
- Assume responsibility for any safety procedures. Hazardous conditions should be reported to the Contractor and, if necessary, to the Field Supervisor.
- Criticize the project design to the Contractor, property owners, or the public.
- Criticize the Contractor to property owners or the public.
- Stop work without authorization of the Construction Manager/Field Supervisor.
- Accept the work or portions of it. This is the responsibility of Construction Manager.

00150.02(c)

INFORMATION/NOTIFICATION PROCEDURES

The Inspector should consult with the following persons to obtain information, give notification, or take needed action:

Manager/Field Supervisor

- Ask the Field Supervisor for further details when required for the proper execution of the work. Request the Field Supervisors interpretation on all matters needing clarification. Refer suggestions or recommendations made by the Contractor to the Field Supervisor. The Field Supervisor may refer the Inspector to the Construction Manager regarding design-related questions, but the Field Supervisor should be the first contact.
- Notify the Field Supervisor or Construction Manager of observed deficiencies in laboratory test results or other materials inspections.
- Notify the Field Supervisor or Construction Manager of material deliveries that are out of sequence.
- Notify the Field Supervisor or Construction Manager if the Contractor's work is impeded by the work of others (e.g., utilities, other Contractors).
- Notify the Field Supervisor or Construction Manager of any field problems. Use the telephone for urgent problems, and memos or notes in the daily progress report for minor ones. Make sure all problems are documented and followed through to resolution. Also, note the resolutions in the progress reports. The Field Supervisor or Construction Manager must also be updated on general project status, the general "feel" of the projects, and any anticipated problems. **Keep them informed.**
- Immediately consult the Field Supervisor or Manager when problems arise that may be beyond the experience or authority of the Inspector to resolve.
- Notify the Field Supervisor or Manager if the Contractor continues to employ methods that pose a hazard to life, health, or property, or will result in defective work that would be impractical to correct or replace subsequently.

00180.85

As a last resort, the Project Manager (Construction Manager or Review Engineer), Field Supervisor, or Inspector may issue Stop Work Orders to suspend work. In case of emergency or unsafe conditions, the Inspector may issue verbal orders to stop work with permission from the Project Manager or Field Supervisor, followed by written notice from the Project Manager.

- Obtain formal (written) notice from the Construction Manager for contract change

orders (CCO) and time extensions.

Contract Manager

- Consult the Construction Manager/Review Engineer as appropriate for information about the project before construction. For example, they can tell the Inspector what problems and complaints may have arisen during the project design, provide lists of legal owners, and furnish sheet-by-sheet quantity breakdowns for assistance in preparing payment documents. The Construction Manager must also be notified of any problems requiring assistance during the construction phase of the project.

Contractor's Authorized Representative

- Communicate directly with the Contractor's authorized representative (i.e. Superintendent or Foreman) or his designated replacement. **00150.40**
- Verbally notify the Contractor of observed deficiencies in laboratory test results or other materials inspections.
- When the Contractor performs or proposes construction that will not meet the requirements of the construction documents, warn him immediately that unacceptable and defective work will be removed and replaced by work and materials that conform to the contract. **00150.02(f)**
- Document all verbal instructions in the daily progress reports. Remember that verbal instructions to a Contractor do not constitute formal notice as defined in the specifications.

The special specifications for most projects state that the Inspector is considered an authorized representative of the City Engineer for the purpose of suspending work. However, the Inspector still **must always obtain permission** from the Field Supervisor, Construction Manager, or Review Engineer before taking these actions.

RELATIONSHIP WITH OTHER PARTICIPANTS

The Inspector must coordinate and maintain a good working relationship with a number of participants during the course of a project. Some of these participants are listed below; additional information is provided in Section 4.

- The Contractor, directly with his authorized onsite representative.
- Other Bureau of Transportation Engineering Technical Services staff:
 - Field Supervisor, Manager (Construction Inspection Section).
 - Review Engineer for permit projects (Permit Engineering Section).

- Traffic Engineer for traffic signs, street name signs, pavement markings, and traffic control plan reviews (Traffic Design Section).
 - Project Manager for contract projects (Project Management Division).
 - Contract Manager for contract projects (Civil Design Section)
 - Surveyors (Survey Section).
 - Utility Coordinator (Street Systems Management Section).
 - Permit Inspectors (Street Systems Management Section) --For other work not covered by a major street, sewer, or water project. Such as new driveways and sidewalks, or utility trenches & sewer laterals under a separate permit.
- Bureau of Environmental Services: Sanitary and Storm sewer construction and inspection and the BES materials testing laboratory.
 - Bureau of Water Works: Water facilities installation, inspection, and maintenance.
 - Bureau of Transportation Systems Management: Traffic signals and street lighting installations, inspections, and management.
 - Bureau of Maintenance: Street name sign, traffic sign, pavement markings, and traffic signal maintenance and/or installations. Trench paving for the Bureau of Water Works and emergency response to public hazards.
 - Bureau of Development Services: Permits and Inspection for erosion and sediment control (ESC), mass grading, and fills on private property, and Special Inspections within the R.O.W. for retaining walls, structures, and unique improvements.
 - Bureau of Parks & Recreation-Urban Forestry Division: tree planting, root inspections, and landscaping.
 - Developers, private utilities, property owners, and the general public.
 - Private surveyors, engineers, and testing laboratories. (On permit projects, the Contractor is responsible for coordinating with these parties; however, the Inspector is responsible for monitoring correct performance/results of their work).

END OF SECTION 2

NOTES

SECTION 3 - TYPE OF PROJECTS

The Construction Inspection Section is responsible for inspecting multiple types of projects:

- **Contract Improvements.** The City (or a consultant) designs the project, puts it out to bid, hires a qualified private Contractor to do the work, and manages the project from start to finish. This includes federally funded jobs requiring ODOT paperwork.
- **Permit Improvements.** The developer/permittee designs the project, hires the Contractor, and manages the construction. The City approves the plans, issues the permit and construction documents, and inspects the construction work.
- **BES CIP.** The City (or a consultant) designs the project, puts it out to bid, hires a qualified private Contractor to do the work and BES manages the project from start to finish.

CONTRACT IMPROVEMENTS

Contract improvements require a higher level of inspection, usually on a full-time basis. The inspector is responsible for measurements, installation notes, and documentation related to materials incorporated into the work. The Inspector works with a technician to ensure pay estimates are completed on a timely basis and supporting paperwork is completed adequately. QA/QC paperwork requirements are highly detailed and exacting.

Local Improvement District Projects

Local Improvement Districts (**LID**) are a special type of contract project. They are managed by the LID Administrator in the Transportation Project Management Division.

Most LID projects are initiated by local residents. All benefiting property owners share in the cost of the LID, whether or not the property owner signed a petition in favor of the LID. Because the project benefit usually varies from property to property, assessments are usually not equal.

LID projects require City Council approval, and are more likely to be approved when there is a majority petition in support of the LID, as measured by the share of costs. The LID process is most commonly used for street projects, but is occasionally used for water, sewer, and other types of projects. The general process is:

- The City designs the project, with input from the property owners within the project "district."
- The City hires a qualified private Contractor to do the work.
- The City provides all the front-end financing.
- The City manages the project from start to finish.

- The property owners within the LID pay the City after the project is complete.

On LID improvements, each property owner pays a designated percentage share of the total project cost. The assessments typically include construction, survey, engineering, project management and financing costs. The assessment is for work in the public right-of-way as well as necessary work on private property that is included in the plans.

It is important to understand that each dollar spent on an LID project is apportioned among everyone in the LID. Therefore, an Inspector must be aware of the incentive for property owners to ask for field changes. For example, a property owner might ask for an unnecessary retaining wall, which if approved, would result in 98% of the cost being borne by the property owner's neighbors.

Although the LID Administrator generally does not solicit work on private property, occasionally the LID Administrator will execute an Extra Work Agreement in which the property owner agrees to pay for an item that is not necessary for the project. The cost of this extra work (including engineering and other "soft" costs) is added to the property owner's assessment. We generally entertain requests for extra work only until the plans are stamped by the City Engineer. After a Notice to Proceed is issued, we generally encourage property owners to privately contract for extra work.

The LID process is also recapped at the following web link:

<http://www.portlandonline.com/transportation/index.cfm?c=35715>

Oregon Department of Transportation (ODOT) Projects

ODOT/Federal Aid projects are another special type of contract project. Federal money can be used for specific types of projects and ODOT allocates the money through Metro. The City identifies projects and applies for money to fund the project through Metro (Lovejoy Ramp, Johnson Creek Blvd, Bybee Overcrossing, etc). The project is evaluated and ranked with projects from other jurisdictions and only the top projects receive funding.

In addition there are also numerous streets in the city that are owned and maintained by ODOT. The City often works with ODOT for projects on these streets.

On projects funded by or through ODOT the City actually pays for the project and then applies for reimbursement by ODOT. In order for the City to get reimbursed, the project must meet ODOT's requirements.

The Inspector is responsible for working with the City's Construction Manager and Technicians to provide inspection services to verify that materials, quantities, and documentation meet ODOT's requirements. If the documentation is not done properly, ODOT may not reimburse the City for all of the costs of the project. This makes it crucial that the documentation on ODOT projects is completed properly and promptly!

The Inspector must be qualified and certified by ODOT to perform inspection for these projects.

The process is as follows:

- The City identifies a specific project that meets the criteria for federal funding.
- The City applies for federal funding for the project through ODOT. The project is evaluated and ranked with projects from other jurisdictions and only the top projects receive funding.
- If the project receives funding, then ODOT and the City enter into an agreement for performing the various phases of the project (Design, R-O-W Acquisition, Construction, etc).
- The City designs the project with input from ODOT or hires a consultant to do the design.
- The City provides all the front-end financing.
- ODOT bids the project and hires a qualified private Contractor to do the work.
- The City manages the project from start to finish.
- ODOT reimburses the City for the project as long as the City fulfills ODOT's requirements.

Oregon Department of Transportation (ODOT) Certified Projects

ODOT certified projects are another special type of contract project. In addition there are also numerous streets in the city that are owned and maintained by ODOT (Powell Blvd, 82nd Ave, Sandy Blvd, etc). The City often works with ODOT for projects on these streets and ODOT has the City design and construct the project. When the project is completed, the City may take over ownership and all future responsibilities related to the improvements.

The Inspector is responsible for working with the City's Construction Manager and Technicians to provide inspection services to verify that materials, quantities, and documentation meet ODOT's requirements. If the documentation is not done properly, ODOT may not reimburse the City for all of the costs of the project. This makes it crucial that the documentation on ODOT projects is completed properly and promptly!

The Inspector must be qualified and certified by ODOT to perform inspection for these projects.

The process is as follows:

- The project receives funding, and then ODOT and the City enter into an agreement for performing the various phases of the project (Design, R-O-W Acquisition, Construction, etc).
- The City designs the project with input from ODOT or hires a consultant to do the design.
- The City provides all the front-end financing.
- PBOT bids the project and hires a qualified private Contractor to do the work.
- The City manages the project from start to finish.
- ODOT reimburses the City for the project as long as the City fulfills ODOT's requirements.

PERMIT IMPROVEMENTS

Permit improvements are projects constructed in the public right-of-way under City permit. They are entirely paid for by the developer or property owner. Permit improvements are managed by the Permit Engineering Section, with inspection provided by the Construction Inspection Section. There are three major kinds of permit improvement projects:

- Subdivision projects (new residential construction).
- Commercial/industrial projects (new construction or reconstruction). Examples include industrial subdivisions, central business district frontage improvements, and special Lloyd Center or River District Improvements.
- Minor projects (low value new construction or reconstruction). Examples include localized frontage improvements, street closures, and intersection revisions.

The process is the same for all three kinds of permit improvements, as follows:

- The developer or property owner normally hires a consulting engineer to design and survey the street improvement project.
- The developer pays an engineering fee deposit, and the consulting engineer submits plans and construction quantities to the Permit Engineering Section for review and approval.
- The City of Portland serves as the approving authority, ensuring the project will be built to current urban standards and regulations.
- Once the City has approved the plans, the Permit Engineering Section Review Engineer develops the final permit fee estimate and the special specifications, and then prints the construction documents for distribution.
- The construction documents are delivered to the Development Services Division Review Engineer, who ensures that the Contractor has insurance, the required project performance guarantee bond, and that all fees have been paid. Development Services then issues the permit and delivers the construction documents to the Construction Inspection Section.
- The Construction Inspection Section provides inspection services to verify that construction work is in compliance with all plans, specifications, and other relevant regulations and requirements.
- Once the permit has been issued, the developer/contractor contacts the Permit Engineering construction manager to schedule the Pre-construction Meeting.
- Once the project reaches substantial completion the contractor/developer requests that a Punch List be generated. The Permit Engineering Section construction manager and the Inspector walk through the project to identify any items needing correction or completion. The Punch List of items is issued to the permittee.
- Upon project completion, the Review Engineer notifies the permittee of the certificate of completion, and Development Services informs the permittee that the performance guarantee can be replaced with a quality assurance guarantee. Development Services does the final accounting on the project at this time.

DIFFERENCES IN INSPECTION PROCEDURES BETWEEN CONTRACT AND PERMIT IMPROVEMENTS

- On contract improvements, projects are surveyed and staked by Transportation Survey Section. When the Contractor submits a written request, the Construction Manager coordinates the staking with the Survey Section. **See Section 6**
- On permit improvements, projects are surveyed and staked by private surveyors. The Contractor is responsible for coordinating the staking. The Inspector must only verify that adequate survey staking is available to construct and check the work.
- On contract improvements, the Inspector measures work, calculates quantities, and prepares progress payment documents for materials furnished and work performed as the basis for payment to the Contractor.
- On permit improvements, the City is not responsible for payment, and the Inspector does not answer payment questions. **See Section 6**
- On contract improvements, the project schedule is regulated by the contract. The City's Contract Manager must approve all extensions and delays.
- On permit improvements, the developer and his contractor regulate the project schedule. It is not a major issue to the City, except as it may affect the inspection budget.
- Testing procedures vary from job to job and depend on whether the City's lab is doing the testing or a private lab is doing the testing. The Inspector needs to monitor that adequate and accurate testing is performed. The Inspector is responsible for scheduling tests when the BES materials test lab is used. Testing procedures and frequencies should be discussed at the pre-construction meeting to avoid confusion. **See Section 8**
- A higher degree of observation, very detailed documentation, and often full-time inspection, is required on contract improvements than on permit improvements. **See Section 14**
- Contract projects may also require the Inspector to have specific certifications and/or additional skills and experience to perform required duties.

END OF SECTION 3

NOTES

SECTION 4 - COORDINATION WITH OTHERS

Every street inspection job requires the Inspector to coordinate with a number of project elements and work with a variety of participants. The ability to understand and oversee the numerous components of a project is critical to the Inspector's job. Even though they may not be directly responsible for certain aspects of the work, they must know who is responsible, what interaction is required, and how this coordination can best be achieved. If the Inspector sees a problem with any other participant's area of responsibility, they should note it in his daily progress report and alert the Construction Manager or Field Supervisor.

This section provides an overview of the various elements that may be involved in a project. For easy reference, it is organized by participant or activity rather than by the responsible bureau or section (for example, "Project Manager" rather than "Permit Engineering Section"). Where additional information about a subject is provided elsewhere in the manual, the appropriate sections are noted.

MANAGER AND FIELD SUPERVISOR

The Section Manager and Field Supervisor are in the Construction Inspection Section of Technical Services, and are the Inspector's primary contacts for information, problem resolution, and needed authorizations. (See "Information/Notification Procedures" in Section 2).

**See
Section 2**

PROJECT MANAGER (Construction Manager OR Review Engineer)

For Contract projects, the City's Project Manager can be a Contract Manager in the Civil Design Section.

On Permit projects, the permittee hires a design engineer for his project. The City's Project Manager is Permit Engineering construction manager

Before starting an inspection job, the Inspector should review the project with the Project Manager (Construction Manager/Review Engineer). (See "Project Review" in Section 6.)

During construction, the Inspector will work closely with the Project Manager (Construction Manager) for Contract projects and should discuss any questions, problems, or construction issues with them for direction or clarification.

**See
Section 6**

On Permit projects, the Inspector should consult the Field Supervisor or Manager first about problems or questions relating to the project design, before communicating with the Project Manager (Review Engineer).

UTILITIES

Coordination

On contract projects, the City's Utility Coordinator (Street System Management Section (SSM)) is responsible for coordinating utility work (e.g., gas, electrical, telephone, cable television). The Inspector can contact the Utility Coordinator for information regarding utilities. The Inspector should also inform the Utility Coordinator (as well as the Manager) of any field problems or conflicts.

On permit projects, the developer or his designee is responsible for coordinating utility work, and all requests for coordination on these projects should be referred to him.

Sewer and Water Construction and Inspection

The Bureau of Environmental Services is typically responsible for sanitary and storm construction and inspection on street improvement projects. The Bureau of Water Works is responsible for water facilities installation and inspection. SSM has street opening permits for BES and PBW. Individual lot connections have separate permits, issued by BDS.

Other Utilities Inspection

Permit inspectors in the SSM Section inspect other utility work.

Additional information about utilities is provided in Section 7.

**See
Section 7**

SURVEY STAKING

On contract projects, survey services are provided by the Survey Section. The Contract Manager relays formal written requests from the Contractor for survey services.

On permit projects, the permittee or developer is responsible for coordinating private survey and construction staking.

The Inspector's main responsibility is to verify that the survey staking is adequate to keep the job going. Additional information about survey staking and the Inspector's duties is provided in Section 6.

**See
Section 6**

MATERIALS TESTING LABORATORY

The Inspector is responsible for scheduling tests when the Bureau of Environmental Services test laboratory will provide materials sampling and testing services. The inspector may also need to call the BES test lab to verify certification tests for pre-cast concrete pipe & manhole products delivered to the jobsite. This verification must be done prior to their installation.

On some permit projects; the permittee may contract with a private laboratory. In these cases, the Inspector monitors the testing by the Contractor and reviews the results. Private test reports go to the Construction Inspection Section office first and are then given to the Inspector to check.

On Contract projects, the Contractor is responsible for scheduling testing for all Quality Control tests and the Inspector coordinates the Quality Assurance testing as needed.

Detailed information about materials sampling and testing is provided in Section 8.

**See
Section 8**

TRAFFIC SIGNS, SIGNALS, AND PAVEMENT MARKINGS

Many street inspection projects require some traffic sign, pavement marking, and/or traffic signal work. For those that do, the procedures described below are followed.

Traffic Signs and Pavement Markings

Traffic engineers in the Traffic Design Section are responsible for overseeing work related to traffic signs and pavement lines and legends. The Traffic Design Section issues work orders for the Bureau of Maintenance (BOM) to install or replace these items.

On contract projects, after all the concrete work and the aggregate base are completed, the Inspector should notify the Contract Manager that it is time to order the signs, unless the sign work is included in the Contractors' scope of work to perform.

On permit projects, the Contractor is responsible for contacting the Traffic Design Section to make these arrangements; as noted on the plans. However, to ensure that timely notification is made, after all the concrete work and the aggregate bases are completed, the Inspector should notify or remind the Contractor to order the signs and also inform the Review Engineer.

An exception is for stop signs, which are installed during construction work, as designated in the special specifications. Stop signs and street signs need to be maintained at all times during construction.

The Inspector should note the date, time, and location of all street sign/signal removals or installations in his daily progress report.

Traffic Signals

Procedures for traffic signals depend on whether the work involves existing or new signals.

- **Reworking Existing Signals:** BTSM directs BOM to install the required modifications. This sometimes involves installing a new pole and transferring facilities.

For both permit and contract projects, it is the Contractor's responsibility to coordinate this work and provide notification to the BTSM. The street Inspector should remind the Contractor of this responsibility.

The Inspector should not allow any work (e.g., sidewalks, paving) to proceed if it could impact signal work.

- **Installing New Signals:** For both permit and contract projects, an electrical Contractor perform traffic signal installation. Construction Inspection is responsible for inspecting the installation (conduit, wire, footing, etc.) and preparing all required documentation (FIR's, installation notes, etc) on contract projects. The Contractor is responsible for notification and coordination with BTSM on permit projects. The street Inspector should defer any questions the Contractor may have to the BTSM inspector on permit projects.

The street Inspector should ensure that the needed coordination is occurring and inspect for compaction, depth and proper location for any trenching, as needed.

Occasionally, urgent traffic signal work may be required (e.g., a dead signal); in that case, the Inspector should directly notify BOM of the need to address the problem.

Street Lighting

Locations for street lights are designated on the project plans. Street lights are generally positioned at lot lines and located to provide optimum illumination. Interferences of which the Project Manager (Construction Manager/Review Engineer) may be unaware are sometimes encountered in the field. In some cases, the problem can be resolved by simply relocating the light. (Approval must be obtained from BTSM.) In other cases, it may be necessary to relocate the interfering surface feature or facility.

Common interferences are driveway approaches, catch basins, future storm drain facilities, fire hydrants, utility poles, overhead wires, guy wires, traffic signals, and trees. The Inspector should determine what interference exists (or will exist later, as in the case of a small tree planted near a light), identify it, measure the distance from the center of the interference to the light, examine the area for an alternate location for either the light or the interference, and identify the owner of the interference. He should then relate this information to the PM (Construction Manager/Review Engineer).

On new subdivisions, the street lighting system is normally installed by the Contractor. On small projects, the utility is normally responsible for installing the system.

BTSM is responsible for inspecting street lighting work for permit projects. As a courtesy, the Inspector should alert BTSM when they see street light work occurring. The Inspector should notify the Review Engineer if the street lighting inspector has not performed the inspection when needed. The Inspector should check street light base locations in relation to curb and sidewalk before the concrete base is poured.

The street construction job cannot be accepted until all street lighting work is completed. (This includes 7-day test burn and as-built records.)

Street Name Signs

After the hard surfacing has been installed on a project the inspector should notify the contractor if street name signs need to be installed. The location of street name signs should be included with the final set of construction plans.

Some permit projects may have the signing to be completed by BOM, due to budget restrictions BOM may not install signs quickly. It may take a month or more for signs to be installed. The Inspector should therefore notify Permit Engineering construction manager as soon as possible.

MAINTENANCE ITEMS

The Inspector should contact BOM in cases of immediate hazard or emergencies, such as sinkholes in the street, plugged sewer lines or inlets, or traffic signal/sign problems. Maintenance should also be notified of defects with City maintained items that are not the responsibility of the Contractor, such as leaky manholes, settled cuts, or downed street name signs. The Inspector should consult the Manager or Field Supervisor if there are any questions.

PRIVATE SURVEYORS, ENGINEERS, AND TESTING LABORATORIES

On permit projects, the developer or his designee is responsible for coordinating with private surveyors, engineers, and testing laboratories. The Inspector is only responsible for monitoring performance and reviewing the results of this work.

CONTRACTORS

As long as the requirements of the construction documents are fulfilled, the Contractor is entitled to complete the work at the lowest possible cost. The Inspector should cooperate with the Contractor in all practical ways so the work can be completed economically, expeditiously, and satisfactorily.

Section 2 discusses the relative responsibilities and authority of the Contractor and the Inspector.

**See
Section 2**

To summarize here, the Inspector's basic responsibilities to the Contractor are to:

- Notify them of any unsatisfactory work or materials as early as possible.
- Advise them about work methods only if asked or if it is evident that acceptable work will not be produced.
- Ask for no more than is required by the construction documents.
- Avoid unnecessarily delaying them by doing inspections and making correction requests not in conjunction with their work schedule.
- Report all completed work promptly and accurately so they may receive monies due (contract projects only).

The Contractor's basic responsibilities are to:

- Do all work and furnish all labor, materials, equipment, tools and machines necessary for the performance and completion of the project in accordance with the construction documents. 00150.10(h)
00180.50(c)
- Determine and be responsible for the method of construction.
- Assume all responsibility for the work, and bear all losses and damages directly or indirectly resulting to the Contractor, the owner, the City Engineer and their officers, agents and employees, or to others on account of the character or performance of the work, unforeseen difficulties, accidents, or any other cause whatsoever, unless such cause is due to any act, omission, or conduct of the owner.
- Give adequate notification for inspections.

The Inspector should observe the following guidelines in order to establish and maintain a good working relationship with the Contractor:

- Maintain an open and helpful attitude toward the Contractor and their employees.
- Discuss the Contractor's work schedule with them. This will help the Inspector coordinate work with others and will make the Contractor think ahead.
- Within limits, help the Contractor interpret the construction documents and the field survey.

- Remain impartial at all times, while maintaining a good rapport with the field crew. The Inspector should continually ask if they are treating all Contractors equally. There is nothing wrong with talking to the crews as long as it does not affect production, but it is not advisable to socialize with them. Even if the Inspector feels that they can socialize without compromising their impartiality, it can be construed as fraternization. Inspectors must always be above reproach and act in a professional manner.
- Give instructions only to the authorized representative of the Contractor, usually the superintendent or foreman.
- Anticipate and resolve potential problems before they occur. The Contractor may also identify possible problems, and the Inspector should listen.
- When appropriate, compliment the Contractor and crews on work well done.
- Do not act as a policeman or parent. The key is to work **with** the Contractor.
- Avoid arguments. The Contractor has a contractual obligation to construct the work in accordance with plans and specifications. The City is obligated to perform timely inspections and to notify the Contractor as soon as possible of any problems. The Inspector does not have to tolerate any verbal or physical abuse and must immediately report such incidents to the Field Supervisor or Section Manager. The Inspector may not engage in verbally or physically abusive behavior.
- Rely upon the construction documents and standard specifications when resolving conflicts. Citing previous experiences and personal opinions can aggravate disputes.
- Promptly refer conflicts outside the Inspector's authority to the Construction Manager/Review Engineer for resolution. A timely reply saves the Contractor time and cost.

PROPERTY OWNERS AND THE GENERAL PUBLIC

During construction of a project, the Inspector will find it necessary to deal with numerous interested people related to the project. Strained relations with any of these people may seriously affect the day-to-day activities of the project. Maintaining good public relations is one of the most important aspects of the Inspector's job.

Effective communication is the basic foundation of good public relations. The Inspector should be pleasant, courteous, and business like in meeting the public. Above all, conduct must be governed by common sense. To the public, the Inspector represents the City. People hold them responsible for accomplishing their work in a manner that affords the greatest public benefit and the least public inconvenience.

On Contract projects, the City contacts affected property owners before the start of construction. During the design phase, information is mailed out and several meetings are usually held in the neighborhood to advise people about the project design and schedule, access limitations, effects on their property, etc. The Inspector may also contact property owners to obtain written permission to work on their property (permit of entry form.)

On Permit projects, it is the developer's or his designee's responsibility to provide information and obtain permission to work on any property other than their own. These pre-construction contacts are further discussed in Section 6.

**See
Section 6**

During construction, the Inspector is the City's primary contact with the public. Property owners or other members of the public may ask the Inspector questions about the project, voice complaints, or request more information. The Inspector should observe the following guidelines when dealing with the public:

- Act in a professional and responsible manner. It is imperative that the public sees the City represented well. The Inspector should be aware that sitting in one spot for long periods could be construed as "camping out." They should portray to the property owners that they are not the "bad guy," but is really their field representative who is there to ensure they are getting what they pay for.
- Avoid arguments. There will be times when arguments seem inevitable. Most can be avoided if the Inspector stops the conversation and sets the ground rules. The Inspector should try to explain the reasons for a policy or decision. They should provide options for addressing a problem--i.e. deal directly with the Contractor, get a variance, or call a higher authority. People should be aware that the Inspector has limited authority and that they want to help them through the process.
- When in doubt, contact the Field Supervisor or Manager. This applies to all phases of work, including public contacts. Owners will view the Inspector as the City's voice in discussions. Much harm will be done if the Inspector makes promises that cannot be kept or "takes sides" with an owner against the City or the Contractor. The Inspector should ask the Field Supervisor or Construction Manager/Review Engineer if they do not know how to respond to a question or request. If there are anticipated problems, the Inspector should let the Field Supervisor or Construction Manager/Review Engineer contact the person(s) involved and observe how the situation is handled.
- Deal with complaints using the following procedures:
 1. Record the complaint and how it was handled in the daily progress report. Include the date and the name and phone number or address of the complainant.
 2. If the complaint was significant, tell the Construction Manager/Review Engineer directly.

3. Follow up to see that corrective action is taken or that an appropriate response is given to the complainant within a reasonable time.
4. Do not take sides in a dispute, or suggest that the citizen may be able to recover damages from the City.

END OF SECTION 4

NOTES

SECTION 5 - OVERVIEW OF DUTIES AND PROCEDURES

This section provides an overview of inspection duties and procedures. It begins with a description of general policies and procedures that apply to all projects. It then outlines inspection tasks typically performed during a project, from pre-construction through project closeout. This section is intended to provide a summary checklist for quick review and reference. Additional information about the Inspector's duties during the various phases of work is provided in Sections 6 through 15; detailed checklists are included in Sections 9 through 13.

GENERAL POLICIES AND PROCEDURES

Inspection Schedule

There are no fixed guidelines governing the frequency and extent of inspection for each project. The requirements will vary according to the circumstances of each job. The Inspector must use judgment and coordinate with the Field Supervisor or Construction Manager to determine the most appropriate schedule.

The following factors should be considered:

- **Budget:** When an Inspector is assigned to a project, the estimated inspection time and materials testing budget are included in the construction documents. The scope of work will be largely defined by these budgets. The Inspector must monitor the time charged to each project and advise the Project Manager of any problems that may prevent the job from being completed within budget.
- **Number of Projects:** When working on a number of projects, the Inspector must divide their time and set priorities so that all required inspection activities are carried out at each location. To help schedule his work, the Inspector should maintain good communication with the Contractors and be aware of their sequence of operation and construction schedules.
- **Size and complexity of the job**
- **Ability of the Contractor's personnel**
- **Weather conditions and time of year**
- **Number of property owners and type of property affected**
- **Unanticipated problems encountered during construction**

Project Workscope and Schedule

On Permit improvements, the developer or designee and the Contractor regulate the project work scope and schedule. The progress of the work is not a major issue to the City except as it may affect the inspection budget and schedule. The Inspector should alert the Field Supervisor if it appears that project delays or problems may cause the inspection budget to be exceeded.

On Contract improvements, the project work scope and schedule are regulated by the contract. If the Contractor fails to complete the project within the time specified in the contract, the City may assess liquidated damages for each day elapsed in excess of the contract time. Conversely, the Contractor may make claims against the City if they consider the City to be responsible for failure to complete the contract work within the prescribed contract time. The Inspector should be aware of time impacts and who is liable for them. The Inspector should advise all parties (Contractor and Construction Manager) when potential penalties or liquidated damages charges are anticipated.

00180.80

The Contractor must submit a construction schedule before work begins, for approval by the Construction Manager. The schedule will show the proposed order of work and the estimated time for completion of the major work items. The Inspector should monitor the Contractor's activity to compare the actual sequence of work and rate of progress to the approved schedule. Any significant changes need to be documented and notification to the Construction Manager.

There are a number of conditions that may affect the scope and progress of the work. Examples are: unsuitable weather conditions, unforeseen site conditions, inadequate equipment or workers, utility or survey delays, obstruction of work by others, or the need for additional work items not included in the contract. The Inspector should watch for these conditions, document them, and report any potential problems to the Construction Manager.

Provisions for making changes to the contract scope or schedule are included in the Standard Construction Specifications and are summarized below. Formal written notice from the Construction Manager to the Contractor is required to authorize any such changes.

- **Suspension of Work:** The Contract Manager may suspend work:
 - 1. For the convenience of the City.
 - 2. When conditions are unsuitable for satisfactory performance of the work.
 - 3. For cause (unsafe conditions; defective or unacceptable work; failure of the Contractor to carry out provisions of the construction documents; failure of the Contractor to carry out orders or directives).

00180.85

The Contractor may also voluntarily suspend work with prior written approval from the Construction Manager.

- **Contract Change Orders:** The Construction Manager may make changes in the materials, operations, time, or amount of work originally designated in the contract. Change orders take precedence over the original construction documents. 00140.30

Payment or credits for any alterations covered by a change order are determined by one or a combination of four possible methods:

00196.10

1. Unit prices
 2. Lump sum
 3. Force account work
 4. The Construction Manager determines payment.
- **Delays and Time Extensions:** The Contractor must notify the Construction Manager of any potential work delay and submit a written request for a time extension. The Construction Manager makes a decision on each request. 00199.30
 - **Differing Site Conditions:** The Contractor must notify the Construction Manager in writing of any pre-existing site conditions that differ materially from those indicated in the contract or from those ordinarily encountered in similar kinds of work. If the Construction Manager determines that conditions do in fact affect the contracted work, they will make an equitable adjustment in the payment or time required for the work. 00140.40

In addition, the Inspector is usually authorized to make minor changes of work to improve the design or functionality of the job; these do not require a change order.

For example, he may adjust saw cut limits to correspond to existing joints or to include areas that have existing cracks. The Inspector will determine the limits of skin patches, re-align driveways with garages. The decisions must be timely (made prior to Contractor's work), and the adjustments should be MINOR. If so, they can be paid as a simple increase or decrease in appropriate bid item quantities.

PRECONSTRUCTION - INSPECTION CHECKLIST:

- Conduct a field check during the design phase to determine if the project is constructible (request will be from Field Supervisor).

- Review the construction documents, with particular attention to the special specifications. The special specifications will have all the additions or changes to the Standard Construction Specifications that apply to that particular job.
- Review the project with the Construction Manager to obtain project background and needed information.
- Conduct a "plans-in-hand" inspection of the jobsite before construction begins.
- Document existing conditions, using a video camera and/or camera.
- Attend the pre-construction meeting (always held for contract projects; frequently held for permit projects).
- Obtain construction authorization forms from property owners (contract projects).
- Obtain additional work requests from property owners (contract projects). Notify the Contractor of additional work not shown on the plans.
- Remind the Contractor to notify property owners of project startup.
- Provide property owners with information about the project: such as schedule, noise, dust, access restrictions, and other impacts on their property (contract projects).
- Review the project with the Contractor before construction work begins, including field review of planned limits and adjustments as needed, tentative schedule, and survey control requirements.
- Review proper salvage procedures for historic concrete stamps, horse rings, and Belgian paving blocks with the contractor.
- Review erosion & sediment control requirements with contractor.
- Review contractors safety plan (contract projects)

UTILITY WORK - INSPECTION CHECKLIST:

- Contact the utility coordinator (in Street Systems Management Section) for any needed information about utilities work (contract projects).
- Confirm that any utility working in the public right-of-way has a permit.
- Remind the Contractor of responsibility to call for underground locates, protect all existing utilities, and to cooperate with utilities working in the construction area.

- Coordinate with the appropriate City inspectors to ensure all utility work is inspected and accepted: (Bureau of Environmental Services for storm & sewer facilities, Bureau of Water Works for water lines and services, and Street Systems Management (SSM) permit inspectors for other utilities).
- Inspect inlets. (Bureau of Environmental Services inspectors may sometimes do this.)
- Notify the Construction Manager or Review Engineer if any needed utility work has not been performed.
- Report any field problems, conflicts, or damages to the Construction Manager or Review Engineer.
- Ensure that the Contractor adheres to applicable criteria for utility cuts.

Traffic Signals

- Verify that material matches submittals.
- Inspect trenching for conduit work in regard to correct depth and compaction effort.
- Pole base construction.
- Ensure that the Contractor notifies and coordinates with BTSM for wire pulling, cabinet installation, wire connections, signal turn on, etc. Do not allow other work (e.g., sidewalks, paving) to proceed, if it could impact the signal work. Inform the Construction Manager of any interference or conflicts with signal work.

Street Lighting

- Verify that material matches submittals.
- Inspect trenching for conduit work in regard to correct depth and compaction effort.
- Pole base construction.
- Ensure that the Contractor notifies and coordinates with BTSM for wire pulling, wire connections, turn on for street lights. Do not allow other work (e.g., sidewalks, paving) to proceed, if it could impact the street light work. Inform the Construction Manager of any interference or conflicts with the work.

Traffic Signs, Street Name Signs, & Pavement Markings

- When City does signing and striping: Ensure that the Contractor notifies and coordinates with Traffic Design Section and/or BOM for sign and pavement marking installations and/or removal work. Do not allow other work (e.g. sidewalks paving) to proceed, if it could impact this work. Inform the Construction Manager of any interference or conflicts with the work.

- When contractor does signing and striping: Ensure that material matches submittals and all documentation for hardware has been obtained prior to installation.

MATERIALS SAMPLING AND TESTING - INSPECTION CHECKLIST:

Sub-grade Preparation

- Visually check sub-grade density by proof-rolling with a loaded dump truck.
- Arrange for compaction tests to be conducted, when needed (deep fills only).

Drainage

- Verify certification of concrete pipe & manhole products with the City's materials testing laboratory.
- Check the markings on HDPE, PVC, or DIP pipe and fittings for size, class, and schedule, etc. to verify compliance with specifications and/or plans. (Write markings on FIR or take a photo)
- Reject any materials that are not approved or damaged and mark them with bright paint, or have contractor store material in a different location for easy identification. The contractor may be able to utilize material on a different project where marking with paint would be detrimental.

Aggregate Base Course Construction

- Visually check for areas of unacceptable material by proof-rolling. Note the size and location of all areas in need of correction, to later verify that all soft spots are dug out and replaced with clean rock (and geotextile fabric if appropriate.)
- Order gradation, sand equivalent, or wash/200 tests, if necessary.
- Order compaction (Proctor) tests to detect any density failures in the aggregate base.

Concrete

- Check truck delivery tickets for the first load of concrete delivered (and periodically thereafter) for the correct, approved mix design number. Reject any load that has no mix number or a wrong number attached to it. Check batch time for 90-minute time limit requirement.
- Schedule any slump, entrained air, and cylinder tests to be performed, as needed.

Asphalt Paving

- Check the first load of asphaltic concrete (and periodically thereafter) for the correct, approved Job Mix Formula (JMF) number. Reject any load that has no JMF number or a wrong number attached to it.
- Check the temperature of the HMAC at the beginning of paving operations and each time samples are taken. Delivery temperature range is 240 to 325 degrees F for HMAC.
- Arrange for testing of asphalt paving compaction density, in accordance with the standard specifications and project requirements.

SUBGRADE CONSTRUCTION - INSPECTION CHECKLIST:

- Ensure that grubbing operations have removed all tree stumps and roots.
- Verify that survey staking is adequate for the job. Coordinate with the Survey Section (contract projects) or Contractor (permit projects).
- Check if excavation and embankment clearances are adequate for construction activities.
- Check for any unusual soil conditions.
- Ensure that the foundation is suitable prior to placing embankment.
- Verify that embankment has been well constructed and compacted as specified.
- Check to see that the Contractor does not unnecessarily over-excavate the sub-grade and remind them to protect it from damage during construction activity.
- Verify that drainage is continuously provided and the sub-grade is sealed when rain is forecast.
- Verify that the Contractor is implementing and monitoring all required erosion control measures. This may include appropriate dust control measures.
- Check sub-grade elevation and cross-section with a string line or otherwise verify the sub-grade depth and typical section (crown or shed).
- Schedule any compaction density tests, as needed, and perform visual inspection deflection test (proof roll) with a loaded truck to confirm stability before approving placement of aggregate base course.

DRAINAGE CONSTRUCTION - INSPECTION CHECKLIST:

- Verify that inlet grates are bike friendly.
- Adjust manholes and utility boxes to fit finish grade.
- Visually inspect completed inlet pipe runs from both ends for crushed or sheared pipe due to improper backfill operations.

AGGREGATES BASE CONSTRUCTION - INSPECTION CHECKLIST:

- Verify survey staking is adequate for construction control.
- Re-check sub-grade elevation and cross-section, if needed, before allowing placement of base materials.
- Verify that drains, utilities, and any other underground facilities are in place.
- Determine if the type and quality of the aggregate base rock is correct.
- Watch for changes in color, source, gradation, or quality of aggregate materials.
- Ensure that the base materials are placed in required lifts and compacted with adequate moisture as specified.
- Schedule compaction density tests, as needed.
- Check the grade, cross-section, and smoothness of the final aggregate base course surface with a string line at 100-foot intervals (or straight edge when necessary)
- Ensure that appropriate dust control measures are in effect.

CONCRETE CONSTRUCTION - INSPECTION CHECKLIST:

- Check for completion of site grading operations, underground construction, and utility clearances before beginning any concrete work.
- Review score pattern and tree well layout with contractor prior to construction.
- Review any test section requirements, if required, with the Contractor.
- Verify that the type of finish is correct for the type of work involved.

- Verify proper drainage at corners prior to pour.
- Check all concrete for the correct strength needed and for approved mix #.
- Monitor that the concrete is being deposited properly.
- Observe the concrete mixture as it is placed to make sure its general appearance and consistency are satisfactory.
- Verify that joint materials are provided and joint methods are done correctly.
- Perform a string line or straight edge check for surface smoothness.
- After concrete placement, check for alignment, grade, depth, slope, finish, and joints.
- Compare the finish and texture of the finished product against the test section, if required.
- Help with layout at wheelchair ramps. They must meet ADA requirements and match up to existing conditions properly. Check that truncated dome panels are approved type, and for proper location and installation.

PAVEMENT CONSTRUCTION - INSPECTION CHECKLIST:

- Check plans and specifications for pavement type, thickness, number of courses, and other project requirements such as curb exposure and match up to existing pavement. Review paving requirements with contractor prior to paving.
- Inspect the aggregate base course; check for grade, cross-section, and compaction.
- Ensure that all underground work is completed and that manholes and valve boxes are visibly marked. Verify with BES and PBW inspectors that all pipe and trench backfill testing has been completed and accepted prior to paving top lift.
- Verify that all contact surfaces and joints are clean and ready for paving.
- Ensure that weather conditions are conducive to proper paving operations.
- Check for good coverage of the tack coat.
- Check tickets to verify asphalt has an approved Job Mix Formula #.
- Verify that paving equipment is appropriate and working properly.

- Monitor that the speed of the paving machine is matched to the rate of delivery from the plant and the rolling operation.
- Check the grade and depth of pavement as it is being laid.
- Watch for low spots, humps, and drainage problems. Make sure longitudinal joints do not end up in wheel path.
- Check that temperatures are suitable for rolling and that the breakdown passes is performed as soon as permissible.
- Evaluate operator performance to ensure rolling operations are acceptable.
- Verify that the rolling sequence pattern and coverage are satisfactory to achieve proper densities.
- Schedule asphalt sampling and testing for gradation and Rice values (when required.)

PROJECT CLOSE OUT - INSPECTION CHECKLIST:

- Ensure that the Contractor has adequately restored and cleaned up the site.
- Conduct a final inspection with the CM/RE.
- Monitor the project during the punch list phase to verify if the Contractor is making timely corrections.
- Conduct a final punch list inspection after the Contractor has completed all the punch list items.
- Sign the "Certificate of Completion" form after all punch list items have been satisfactorily corrected and/or completed.
- Prepare two sets of as-built drawings with **red ink**.
- Submit project closeout information to the FS on permits and CM on contracts.
- Check the completed job occasionally when nearby and time allows.

DOCUMENTATION - INSPECTION CHECKLIST:

- Complete a daily progress report for each project visited (Daily).

- Keep a daily tabulation of hours charged to each project.
- Prepare field inspection report (FIR) for materials.
- Prepare payment installation notes and drawings. (Contract projects only)
- Conduct employee wage interviews. (Contract projects only)

ONGOING RESPONSIBILITIES - INSPECTION CHECKLIST:

- Check regularly with the Contractor's onsite representative to monitor the work schedule and address any problems or questions.
- Keep ahead of the work being performed in order to anticipate items that might interfere with the progress of the construction.
- Verify that the Contractor is using appropriate equipment and methods consistently throughout the project.
- See that the Contractor confines his work to the right-of-way and easements and does not encroach upon or damage private property.
- Take photographs or videotape the project as necessary to document construction progress, contractor damage, unusual conditions, or potential problems.
- Ensure that proper traffic control measures are in place and being maintained.
- Ensure that residents have access to the front of their homes after construction work hours.
- Confirm that the Contractor is following appropriate public safety methods, such as protective covers, fences, barricades, lighting, warning devices, and signs.

TWO-YEAR WARRANTY CHECKS:

Any transportation improvement that our group inspects has two different types of bonds that are required.

- 1) Performance Bond - It guarantees that if the Contractor/Permittee is unable to construct or complete the project that the bonding company would work with the City to complete the project.
- 2) Warranty Bond - It warrants the materials and workmanship for a project for 2 years after substantial completion of the project

Before the Warranty Bond expires, the Field Supervisor assigns an Inspector go out to the project with a set of plans to see how the project improvements are holding up. .If there are any problems, they should be noted on the plans & photo(s) taken. The Office will work with the Contractor/Permittee or the bonding company to make any necessary corrections.

END OF SECTION 5

NOTES

SECTION 6 - PRECONSTRUCTION

The Inspector has a number of tasks to perform before construction on a project can begin. This section describes each of these tasks in the sequence they should ordinarily be done.

FIELD CHECK

A field check is performed during the design phase of a project. It is a preliminary design check to see if the project can in fact be constructed according to the proposed plans. The Inspector will be involved; this is often his first exposure to the project.

The following items should be evaluated during a field check:

- Are the plans accurate and complete?
- Are driveways, fences, trees, shrubs, utilities (poles, hydrants, meter boxes, valves, and manholes), signs, encroachments and other details shown?
- What is the condition of pavement adjacent to the improvement? Any failures? Puddles? Is existing pavement new?
- Are there any errors in grade, drainage problems, trees and shrubs, or slope catches (i.e., is there enough right-of-way to build the section without encroachments or easements or severe damage to the adjoining property)?
- Does the design generally fit the locality? (For example, is there a need for a difference in curb elevations which would necessitate an offset crown? Could the grade be revised to eliminate severe cuts or fills that damage the adjoining property?) Carefully check matchups to existing conditions.
- Are accesses and haul routes adequate? Are access routes likely to be damaged by hauling activities? Will hauling disturb adjacent residents?
- Are detours required? Are adequate detour routes available? Will traffic be impacted significantly? Can pedestrians go around the project safely?
- Are project boundaries clearly marked?
- Are there any unusual conditions or potential problems (drainage, slide potential, bus routes, churches, and schools, overhead obstructions such as power lines or tree branches)?

All suggested changes or revisions should be marked in red ink on the field check plan. There is also a checklist to be filled out by the Inspector doing the field check.

CONSTRUCTION DOCUMENTS:

When assigned to a project, the Inspector is given a set of construction documents, which govern the work to be done. The construction documents include the plans, street permit, special specifications, and bid price tabulation. On permit projects, these documents are bound and referred to as the "blue book."

The Inspector is responsible for monitoring compliance with the construction documents and should become thoroughly familiar with them. It is especially important for the Inspector to read the special specifications carefully and make sure they understand any special conditions that apply to a particular job. The Inspector should consult the Field Supervisor or Construction Manager to clarify any unfamiliar or unusual materials and methods or to answer any other questions about the construction documents.

In case of conflict, the **order of precedence** of documents in controlling the work is as follows. Any conflicts should be pointed out to the Manager.

00150.10

1. Permits from Outside Agencies required by law
2. Change Orders
3. Addenda
4. Special provisions
5. Plans
6. Information furnished by notes and/or schedules on drawings
7. Large Scale Drawings over small scale drawings
8. Standard Details and Standard Drawings
9. Standard specifications
10. All other contract documents not listed above

PROJECT REVIEW

The Inspector should review the project with the Construction Manager to provide a link between design and construction. This will enable the Inspector to learn about relevant aspects of the project that occurred during the design phase and to obtain information needed during the inspection phase. The kinds of information useful to the Inspector include:

- Special problems encountered during design.
- Latitude for minor changes (critical spots in design).
- Complaints from property owners.
- Lists of legal property owners (contract jobs only).

- Sheet-by-sheet quantity breakdowns for assistance in preparing monthly payment documents (contract jobs only).

JOBSITE INSPECTION AND DOCUMENTATION

Before construction begins, the Inspector should make a "plans-in-hand" inspection of the jobsite for the following purposes:

- Compare the plans to actual site conditions. The Inspector should check for:
 1. Dimension errors.
 2. Conflicts with topographic items such as trees, shrubs, retaining walls, utility poles, hydrants, valves, etc.
 3. Changes that have occurred since the plans were drawn, such as new buildings, parking lots, removal of existing buildings, or newly paved roadway.
 4. Cuts and fills for "fit."

The Inspector should notify the Construction Manager of any problems found, so the necessary changes can be made.

- Determine potential problems or unusual conditions before the Contractor moves onto the construction site. Again, any conflicts should be brought to the attention of the Construction Manager.
- Document existing conditions. This should include both existing damage and improvements that are in undamaged condition but could be affected by the Contractor's activities.

Video Documentation

The Construction Inspection Section uses a video camera to document existing site conditions. The video should include both overall views (longitudinal views of each street to be constructed from each direction) and details of each property (e.g., each driveway to be matched). The specific items to record include:

- Cracks in sidewalks and driveways (highlighted with marking crayons).
- Sunken or shifted curbs.
- Dead or barren lawn areas.

- Damaged trees.
- Broken window glass.
- Cracks and chips in buildings and walls.
- Fences in need of repair.
- Items to be removed and salvaged (fences, bushes, etc.).
- Items to remain (fences, trees, bushes, etc.).
- Conditions of all roadway surfaces adjacent to the project that can or will be used during construction (potholes, ruts, cracks, mud, etc.).

A good video record is critical for resolving any disputes regarding the condition of existing improvements before construction began.

Photographic Documentation

Videos have generally replaced photographs for documentation of existing conditions. However, digital photographs should be taken as necessary before or during construction if a video camera is not available. Photographs may be needed during construction to document problems such as muddy sub-grade after a rain, accidents, damage to private property, or vandalism. If you have any question about a situation, take a picture. Try to document progress as each phase of construction is completed, with a sequence of dated photos taken from the same general location (contract jobs).

The procedures for logging videotapes and photographs are provided in Section 15.

**See
Section 15**

PRECONSTRUCTION MEETING

A pre-construction meeting is always convened for contract projects and is often done in the field for permit projects. The meeting takes place after the bid award and before construction begins. The purpose of the meeting is to go over the construction documents, discuss any special conditions, review the schedule, go over survey and test requirements, and generally ensure coordination among all the involved parties. The meeting is led by the Construction Manager and is generally attended by the Manager, design engineer (if different from the Construction Manager), utility coordinator, representatives from private and public utilities, Survey Section staff, contract compliance officer, Field Supervisor, and Inspector. Be sure to go over requirements for notification prior to pouring concrete or beginning paving.

PROPERTY OWNER NOTIFICATION

On permit projects, the developer or his designee is responsible for providing information and obtaining permission to work on any property other than his own. The following information about property owner notification applies only to contract projects.

For Contract projects, property owners first receive information from the City during the design phase of the project. The assessor's office sends formal notice of the project and the assessment amount. Several meetings are usually held in the neighborhood to advise people about the project design and schedule, access limitations, effects on their property, etc.

For Local Improvement District Contracts, the property owners receive invitations from the LID Administrator to attend one or more property owner meetings during the design phase of the project to advise them about the project design and schedule, access limitations, impacts to their property, etc. Property owners' knowledge of the project will depend in part on whether they have attended any of these meetings. Before any construction begins, the LID Administrator recaps the individual design details for each property in a letter to each property owner.

Construction Authorization

A Permit of Entry is required to perform any work on private property. No Permit of Entry is required if all work is in the right-of-way, but all property owners are typically asked to sign a Permit of Entry in case there are field changes requiring work on private property. Before construction of the project begins, the property owners are asked to sign and return their Permit of Entry form in a postage-paid return envelope. This includes legal owners who do not reside on the property.

The LID Administrator or Construction Manager can provide the Inspector with a list of legal property owners. The Inspector should review this list as early as possible to determine the number of contacts that will be necessary and to identify absentee property owners who may be difficult to contact. If the property owner's authorization is not obtained before construction begins, all of the work (including driveways) behind the property line must be eliminated. The Inspector may need to point this out during his contacts.

Field Changes

All major field changes should be prearranged with the Construction Manager and noted on plans. Minor field changes should be prearranged with the Construction Manager. The goal is to minimize field changes to the extent possible and build the project in accordance with the final plans. However, if you foresee a problem in constructing an item shown on the plans, bring it to the attention of the Construction Manager and LID Administrator as soon as possible to minimize the costs of redoing work.

Other Information

Once the Permit of Entry has been obtained and the LID Administrator contacts property owners to advise them of construction abutting their property, the Inspector should be prepared to provide them with the following information about the project:

- How long the project is expected to take.
- How the project will affect access to their property. The Contractor can deny access to properties during working hours (except for emergency vehicles); but they must provide access to the front of the property (not into the driveway or garage) after working hours.
- Other impacts that can be expected, such as noise, dust, or landscaping issues and information about property owner rights (e.g., salvage of trees, shrubs, firewood).
- Contact information for the Local Improvement District Administrator (503-823-5648 or andrew.aebi@portlandoregon.gov), who tracks, logs and follows up on all contacts, requests and inquiries. It is important for property owners to have a centralized point of contact to prevent “shopping” for answers among multiple City/contractor staff. The city does maintain a website that can provide property owners with project specific items.
- Identification of private improvements that will be affected by the work and will have to be removed (fences, plants, sprinkler systems, mail boxes, concrete or masonry work, etc.) The project plans will include information about what and how improvements are to be removed. The following guidelines apply:

1. Fences:

If a fence is on or behind the property line, the City takes it down and reinstalls it or builds a new one (at the City's option). The City generally does not build wood fences, but may do so if the property owner agrees to pay the difference between a metal and wood fence.

If a fence is inside the right-of-way and is salvageable, the City stacks it on the private property; the property owner reinstalls or disposes of it. The City does not compensate property owners who have installed fences that encroach on the public right-of-way.

2. Vegetation:

If vegetation is in the right-of-way, the property owner may move them before construction. If it is not moved, it is the Contractor's prerogative to dispose of it. The Contractor is not obligated to transplant vegetation because of the high mortality risk.

If vegetation is on private property but within work areas, the LID

Administrator will arrange how they will be handled with the property owner.

3. Trees:

The City Forester determines if trees are to remain or be removed. If trees are to remain, the forester determines if the design will harm them, and works with the Construction Manager to reach agreement on the design. The City Forester identifies all trees needing exploratory excavation for tree roots.

See
Appendix D

The Contractor is responsible for providing 48 hours notice to adjacent property owners of tree removal from the street right-of-way. Property owners have **7 days** to remove the timber after felling.

4. Sprinkler Systems:

Private sprinkler systems within the public right-of-way are not permitted. If lines are encountered during construction, the Contractor's only obligation is to cap the lines at the limits of construction. The contractor is also required to give reasonable notice to property owners to remove or relocate all private facilities within the right-of-way.

A week before construction begins; the Contractor should notify property owners of the project startup. The City provides door hangers to the Contractor for this purpose at the pre-construction meeting. The Construction Manager may have to remind the Contractor to distribute the door hangers.

SURVEY STAKING

On contract projects, survey services are usually provided by the Survey Section. The Contractor must make formal requests for survey work in writing or email to the Inspector/Construction Manager. The contractor is informed of current procedure for making survey requests at the pre-construction meeting. Inspectors should receive copies of notes from the Survey Section and will need to check grades and alignment during the construction.

00150.15

Inspectors may assist the Survey Section in the following ways:

- Help them schedule their work by informing them which streets are in need of stakes and when.
- Help them determine offsets, as needed by the Contractor.
- Contact them to replace critical stakes that may be lost or damaged during construction, or to resolve any other problems.

On permit projects, the developer or designee is responsible for coordinating survey

staking. The Inspector should:

- Inform the Contractor, if necessary, what stakes are necessary to control the work.
- Verify that enough survey control is available to check the work. If insufficient control exists, the work should not be allowed to proceed.
- Inform the Contractor of any survey problems that need to be resolved.

Normally, two sets of stakes will be provided for street construction. A first set of rough grade stakes or slope stakes, set every 50 feet, will be set back at property line or beyond. After excavation to sub-grade, a second set of "finish grade" stakes will be set referencing top curb, face curb (typically every 25 feet in tangent, but may need to be closer in curves).

One set of stakes referencing top curb and face curb (TCFC) or (TFC) is sufficient if cuts on the project are shallow. Line and grade for sewers is also provided. Exhibit 6-1 shows the type of information typically provided on a stake.

One of the Inspector's main responsibilities is to check that the survey staking is adequate to keep the job going. This involves identifying and anticipating any problems that may cause delay to the Contractor. In general, the Inspector should perform the following survey checks:

- Check the conditions of stakes.
- Check to make sure the writing is legible.
- Check to make sure there are no stakes missing for designed changes in alignment or grades. (i.e. PC, PT, PVC, GB, Angle points, etc.)
- Obtain survey cut sheets from the Survey Section or Contractor's surveyor.
- Compare the cuts and fills shown on the stakes or notes to the grades from the approved plans for general conformity.
- Check alignment and grade where matching existing structures or surfaces.
- Review stakes with the Contractor and advise them of responsibility to protect them. Be sure the Contractor understands what the stakes mean.
- If the Inspector knows the location of monuments, including property corners, relay this information to the Contractor so they can protect them from disturbance. Expect the City surveyors to point out locations of jeopardized monuments and property corners.

- Request additional stakes, if asked by the Contractor, or if any are missing. Be sure the Contractor knows they are liable for stakes lost through their own negligence.
- Cross check the survey hubs opposite each other once per block by measuring the distance between them, then subtracting their offsets.

00150.15

PROJECT REVIEW WITH THE CONTRACTOR

The Inspector should review the project with the Contractor before construction work begins; some of this is covered at the pre-construction meeting. The discussion should cover anything necessary to ensure that problems will be avoided and the project can proceed smoothly. Generally, this will involve:

- A general review of the plans, specifications, and schedule.
- Identification of any special conditions that require particular attention.
- Identification of the Contractor's staff and subcontractors; telephone numbers.
- Communication of any relevant information the Inspector has obtained from property owners.
- Reminder to the Contractor to provide all notifications required by the specifications.
- Review of job safety requirements, traffic control, and other general work requirements (e.g., noise ordinances, dust control).
- Field review of the actual location of planned limits of work and adjustment as necessary (e.g., move sawcuts, alter driveways, adjust wheelchair ramp locations).

SALVAGE AND HISTORIC PRESERVATION

The Inspector should be aware of salvage procedures that are required and ensure that they are followed by the Contractor throughout the project.

Horse Rings

When a metal horse ring is contained in a section of curb to be removed, the Contractor should remove the horse ring assembly without damage and reinstall it in the new curb as close as practical to the same project stationing. In the event that no curb is replaced, such as a new driveway location, the Contractor should save it and contact the Inspector for instructions.

00310.41(d)(6)

Belgian Paving Blocks

The Contractor must preserve quantities of 150 or more cobblestones (Belgian paving blocks) that are removed in the course of excavation.

00310.41(d)(5)

These blocks become the property of the project owner. The Contractor should notify the Bureau of Parks (Operations Division) of the location and estimated quantity of blocks and then deliver the blocks to a site designated by the Bureau. The Contractor assumes ownership of quantities less than 150 and may dispose of them at their discretion. The Contractor must schedule a time to deliver with Parks and Recreation at (503) 823-3643.

Historic Concrete Stamps

The City has a policy of salvaging significant historic concrete stamps when they are removed during construction. This is limited to street names and/or dates; it does not apply to Contractor names. They are usually identified during the design phase and noted on the plans; if not, the Inspector should notify the Contractor and Construction Manager.

Additional information is included in Section 12.

**See
Section 12**

END OF SECTION 6

NOTES

REFERENCE POINT STAKE FOR CURB AND GUTTER. ALL MEASUREMENTS
MUST BE MADE FROM THE TACK IN THE HUB.

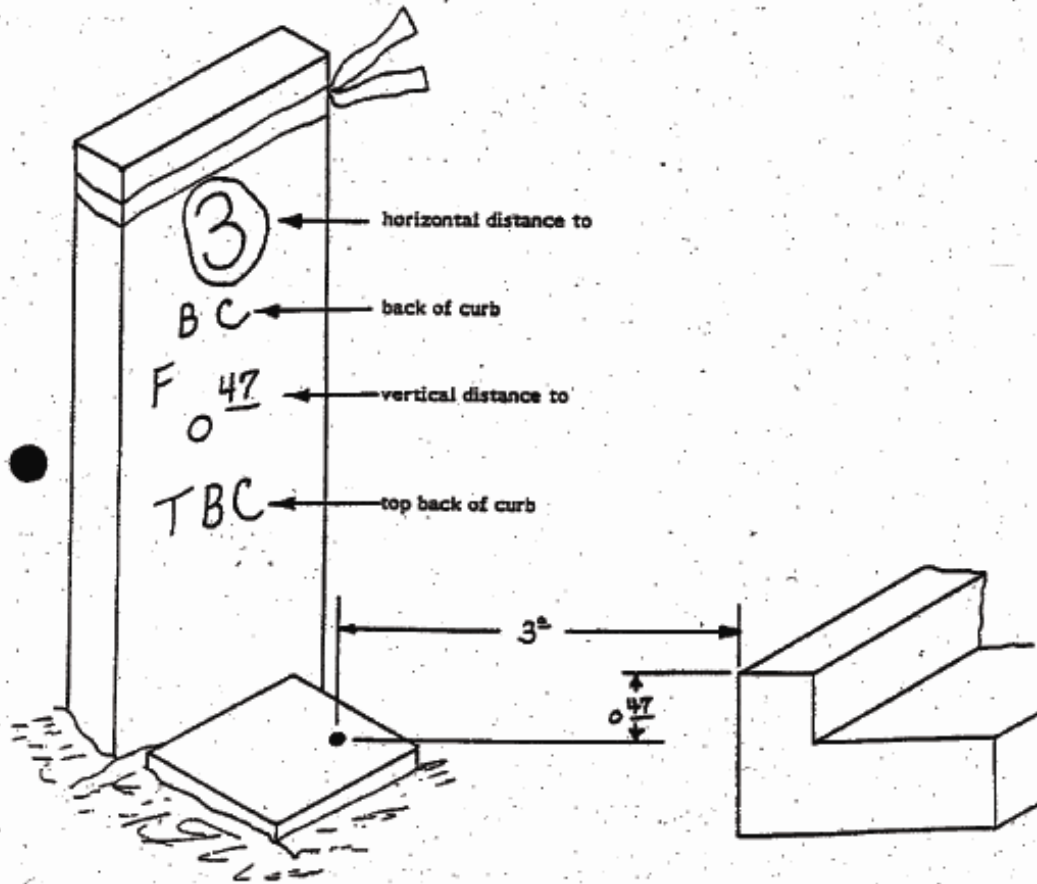


Exhibit 6-1

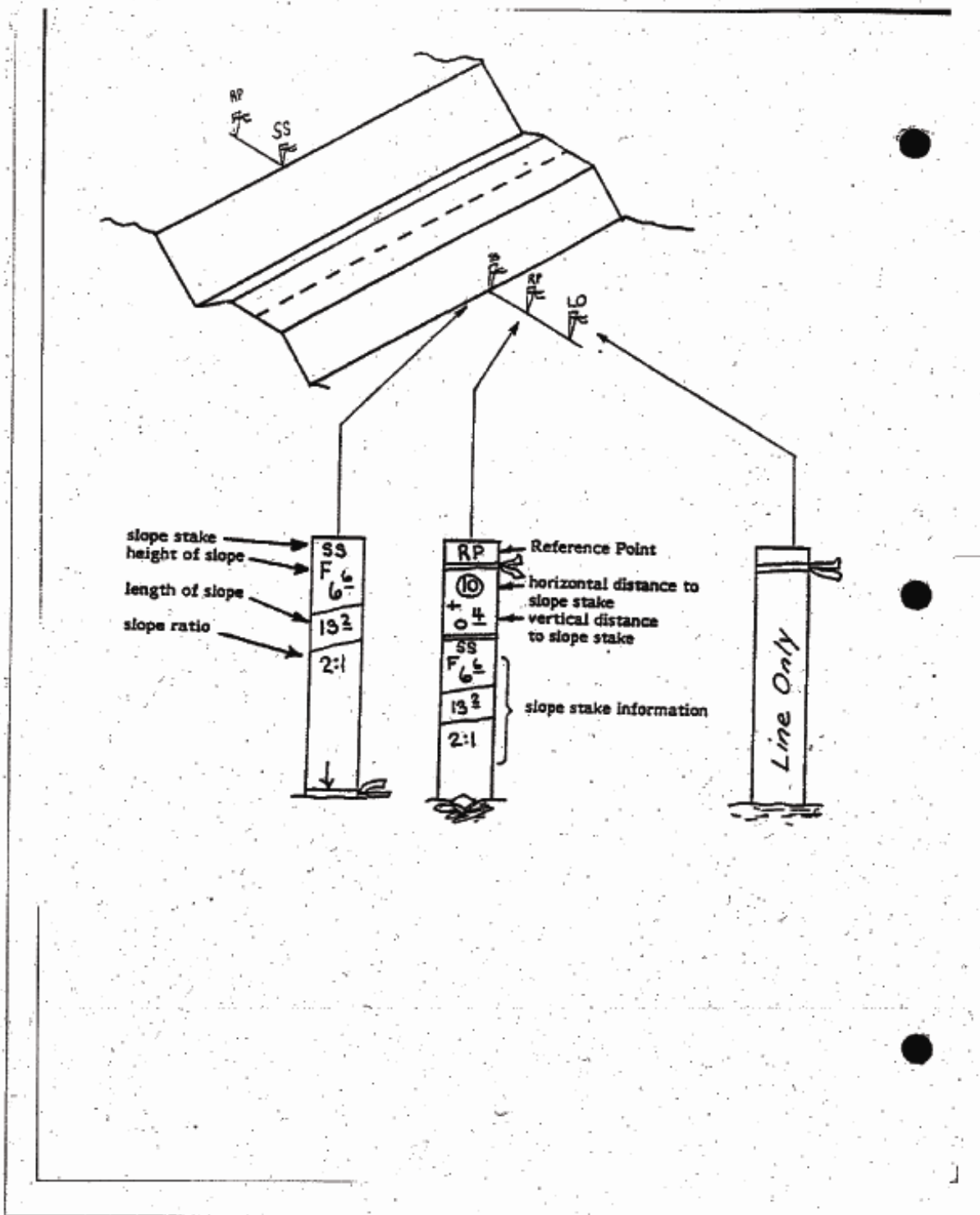


Exhibit 6-1

SECTION 7 - UTILITIES

Most public improvement contract projects are located in developed areas, either business or residential. Such areas always have utilities that must be considered in the design and construction of the improvement. On permit projects, additional utility services are often needed to serve undeveloped land.

Construction may be delayed if utilities have not been moved or installed, or were moved or installed in the wrong sequence, or to the wrong location. Good coordination of utility work is essential in order to complete the project in sequence and on schedule.

It is the Contractor's responsibility to take proper precautions in performing work to avoid damage to utilities. There is almost no limit to the variety of utility interferences that can occur during construction, especially in older, heavily built-up areas for which records may not exist or are inaccurate with respect to new improvements. Both the Contractor and the Inspector should be on the alert for interferences. They must fully cooperate with each other to minimize the hazard to life and property and the inconvenience of service outages that can result from accidental damage to utilities during construction.

00150.50

The Inspector's duties with regard to utilities are limited. The main responsibilities are to:

- Confirm that any utility working in the public right-of-way has a permit.
- Remind the Contractor of responsibility to call for underground locates, to protect existing utilities, and to cooperate with utilities working in the construction area.
- Coordinate with the appropriate utility Inspectors in the Street System Management Section (SSM) as well as BES, PWB and BTSM Inspectors.
- Inspect storm inlets.
- Notify the Construction Manager if any needed utilities work has not been performed.
- Report any field problems, conflicts, or damages to the Construction Manager.

In order to perform these duties, the Inspector must have an overall understanding of who is responsible for the various aspects of utility work. This section discusses permits, coordination, inspection, and other background information relevant to water, sewers, and other utilities (gas, electricity, cable television (CATV), telephone). Information about street lighting, traffic signs and signals, and street name sign installation is provided in Section 4.

**See
Section 4**

UTILITY PERMITS/COORDINATION

On Permit improvements, the permittees and/or their consultants are responsible for coordinating utility work, and all requests for coordination on these projects should be referred to them.

00150.50

On Contract improvements, the City's utility coordinator in the Street Systems Management Section (SSM) works with the City's Construction Manager to coordinate street improvement projects. The utilities are kept informed about the scope, possible impacts, and intended schedule of the improvements during the design phase. The process for utility permits and coordination is as follows:

The utility coordinator provides utilities with copies of the City's street improvement projects as they are being designed. This enables the utilities to review the plans and verify that their existing facilities are correctly shown. They may also need to install new facilities or relocate/upgrade their existing facilities in coordination with the project improvements. The utilities must submit their work plans and request a permit before they undertake their work within any public right-of-way. The utility coordinator authorizes the permits, which are then issued by the Street Systems Management Section. (Note: BES and PWB are also included in this review and plan approval process.) The utility coordinator keeps copies of all utility permits that impact street projects under design or construction.

Utilities are encouraged to complete any work within the project area before any street construction; however, in new developments, utility work may occur during or after the street work.

The Inspector should contact the utility coordinator if there are questions about utility work (e.g., which utilities serve the project area, which are known to have facilities within the proposed street project, is the location shown on the drawings correct, which utilities have obtained permits for work within the project). The Inspector can obtain information about the progress of any utility permit work by contacting the utility coordinator and/or the appropriate permit inspector (See "Utilities Inspection," below).

The Contractor is required to call all affected utilities at least 2 business days, but not more than 10 business days, before digging so the utilities can locate and mark their underground facilities. The Inspector should remind the Contractor of this legal requirement. This may not only prevent a service outage, but could also prevent serious injury. OAR 952 gives detailed information.

There are many utilities within the City. Often, more than one power, phone, or CATV utility may serve the street improvement area. Exhibit 7-2 shows a chart that may be printed on the construction documents. It indicates some, but not necessarily all, of the utilities that may be found on a project.

UTILITIES INSPECTION

Sewer

On most projects, an inspector from the Bureau of Environmental Services (BES) is assigned to inspect sewer construction. Occasionally, the street Inspector conducts sewer inspections on smaller projects, under the supervision of BES. If this is required, the Inspector's duties will be identified at the time. SSM will inspect individual sewer connections and minor manhole extensions.

It is very important that the Contractor understands who is responsible for inspections and that inspectors normally don't cross jurisdictional lines. In general, the BES Inspector will inspect all sanitary and storm sewer construction, except storm inlets. These are the responsibility of the street Inspector (although they may sometimes be inspected by BES). Additional information about inlets and leads is contained in Section 10.

The street Inspector should check-in with the BES inspector often to check on the work's progress and general status. When the sewer portion of the project is complete, any information regarding testing or acceptance issues should be passed on to the street Inspector as soon as possible.

**See
Section 10**

On all projects inspected jointly by street Inspectors and BES inspectors, it is important to contact the BES inspector before base lift paving. The BES inspector should be contacted as soon as an accurate paving schedule is established. This is to determine if any remaining items on the sewer portion of the project could impact the paving and if paving work needs to be rescheduled to allow completion. The street Inspector must verify that all sewer construction is substantially completed and all testing is accepted prior to the top lift.

It is also important to coordinate any punch list work to eliminate delays in completing the project, and to make sure that punch lists prepared by each inspector are limited to their respective sewer or street items.

Water

The Water Bureau is responsible for inspecting water facilities. The street Inspector should verify that the Water Bureau has conducted trench compaction testing, hydrostatic tests, chlorination and Bacteria tests, and completed all connection work to existing water lines prior to the top lift of paving. Also, service lines to the curb line on new main installation should have been completed.

Utility inspectors in the Street Systems Management (SSM) Section sometimes inspect water facilities for location, depth, trench compaction, and pavement restoration, normally on small jobs or new service installations.

Other Utilities

The inspectors in the Street Systems Management (SSM) Section typically inspect all utility work for location, depth, trench compaction, and pavement restoration. Occasionally, the street Inspector may be required to perform these inspections.

The street Inspector should notify the appropriate SSM Inspector of any work in progress that requires their presence. The street Inspector should also notify the SSM Inspector of any problems or occurrences that may affect remaining street improvement work (e.g., inadequate compaction, location changes).

Inspection of utilities (water, gas, electric, phone, cable, etc.), whether newly constructed or relocated, should be tracked separately. Time spent inspecting utilities should be charged to SAP #9tr000000170.

ADDITIONAL INFORMATION ABOUT UTILITIES WORK

The power company is the key to coordinating power, street lighting, telephone, and cable television. The telephone and cable television companies will wait until they have seen the power company's drawings before drawing up their own plans. They will try to use the power company's ditch as much as possible if the utilities are to be underground; if the utilities are aerial, they will try to use the power company's poles before deciding if they must install their own poles or underground portions of their work.

When power poles are relocated, the utilities relocate from the top of the pole down to the last utility on the pole, and each utility may cut the old pole off just above the next lower utility to allow them to lift the wires over the pole to attach to the new pole. Since fire alarm and traffic signal wires can also be on these poles, as well as signs owned by Tri-Met or the Bureau of Traffic Systems Management, the relocation can take some time. The old poles are usually removed by the last and lowest utility on the pole; however, since cable television may not have equipment to remove them, check with the utility coordinator when cable television seems to be the lowest on the pole. (The owner of the pole may be required to remove it.) The owner is generally shown on the power company's engineering drawings, which are usually furnished to the utility coordinator before the permit is issued. Exhibit 7-3 shows typical joint-use pole installation.

Exhibit 7-4 shows minimum height requirements (under most conditions) for overhead electrical wires or anchor (guy) cables.

In underground utility areas within the City, most cable television companies will install conduits for future service if they are notified in time to coordinate their work with other utilities and if there is an open ditch they can use.

The gas company will design and install new facilities or relocate their existing facilities as required for improvement projects. They now use polyethylene pipe, which allows them to place their lines closer to power lines than the old metal pipes. The plastic pipe is installed with a trace wire, and care should be taken when digging around them to avoid damage to either the pipe or wire. Steel gas pipes are coated to provide cathodic protection from electrolysis. If the coating on a gas pipe is damaged, the gas company must inspect and repair it. If the repair isn't done the line will rust and eventually fail at the damaged location.

Most of the water facilities in the City are owned and operated by the City Water Bureau; to be sure, check with the utility coordinator on each project. Water mains are usually installed in the pavement area, 6 feet from the south or east curb lines. The Water Bureau or the Contractor may install new water mains and occasionally the meter service line(s) from the new main. Only the Water Bureau may make connections to the City's existing water system or install/replace water meters. Only the Water Bureau or a licensed plumber can connect the house service to a water meter. The Water Bureau also adjusts water meters (horizontally and vertically) prior to or during sidewalk construction, but the Contractor adjusts the meter boxes to finish grade just before the concrete is placed.

The City Code (Chapter 17.24.100) does not allow cutting into a new street for **5 years** after construction. The utility coordinator normally sends letters to all owners of vacant properties to inform them of this. The property owners can then make arrangements, if desired; to have utility services installed on their property before street construction begins.

UTILITY CONFLICTS AND DAMAGES

Reporting Utility Conflicts

- Report any utility conflicts encountered in the field to the Construction Manager or Utility Coordinator.
- Identify the utility involved.
- Identify whether the conflict is vertical, horizontal, or both.
- Identify how soon the conflict needs to be resolved.

Reporting Utility Damages

- Identify the utility involved. Calling the wrong utility only delays the repair.
- Report the problem directly to the utility company if possible. The Inspector will know more about the problem than anyone in the Office, since they have seen it personally. Also report the problem to the Manager, Project Manager, and Utility Coordinator.

- Let the utility know how serious the problem is. For example, tell them whether it involves a service to one house or the main line, and whether it is dripping, flowing, or shooting to the treetops.
- Always identify the location by street address when possible. Repair people will probably not have street plans, but they can still find the site and determine which side of the street is involved if they have the address.
- To avoid misunderstandings, give the address of each house known to be affected.

OTHER SUGGESTIONS

- Do not allow possibly damaged utilities to be buried until the owner of those facilities has checked them and has determined their facilities are not damaged, or has completed repairs to their satisfaction.
- Water facilities are not to be operated or repaired by anyone other than the City Water Bureau (except fire hydrants, with a proper permit).
- Fire hydrant users must have a Chapman valve, backflow device, meter, and a permit from the Water Bureau. If not, they should be reported to the Water Bureau.
- All water valves must remain accessible for the Water Bureau to operate the system during construction. All valve boxes must also be adjusted during paving operations to allow access for them to operate the system.
- Leaks to a house water service line should be stopped temporarily by either driving a wooden plug into it or bending the copper tubing over and crimping as tightly as possible. Do not shut the water off; only the Water Bureau can do this.
- Power poles with ground wires (usually #6 bare copper wire shielded with a wood or plastic strip to prevent touching by pedestrians) will have a ground rod attached to this wire near the pole base. (Poles with a box that says "alpha" on it will have two ground rods 3 feet from the pole on different sides.)

UTILITY CUTS ON STATE HIGHWAYS

Certain criteria apply to all Oregon State Highway Division (OSHD) maintained roadways within the City of Portland corporate limits for which the City issues street opening permits. The construction documents should designate projects that fall under this category; if in doubt, ask the Field Supervisor or Manager. These criteria are contained in Exhibit 7-6.

END OF SECTION 7

NOTES

NOTICE OF EXCAVATORS:

ATTENTION: OREGON LAW REQUIRES YOU TO FOLLOW RULES ADOPTED BY THE OREGON UTILITY NOTIFICATION CENTER. THOSE RULES ARE SET FORTH IN OAR 952-001-0010 THROUGH OAR 952-001-0090. YOU MAY OBTAIN COPIES OF THE RULES BY CALLING THE CENTER.

(NOTE: THE TELEPHONE NUMBER FOR THE OREGON UTILITY NOTIFICATION CENTER IS (503) 232-1987).

POTENTIAL UNDERGROUND FACILITY OWNER

DIG SAFELY.

CALL THE OREGON ONE-CALL CENTER
1-800-332-2344

EMERGENCY TELEPHONE NUMBERS

NW NATURAL GAS	
M-F 7AM-6PM	503-226-4211 EXT. 4313
AFTER HOURS	503-226-4211
PGE	503-464-7777
QWEST	1-800-573-1311
CITY BUREAU OF MAINTENANCE	503-823-1700
CITY WATER	503-823-4874
VERIZON	1-800-483-1000

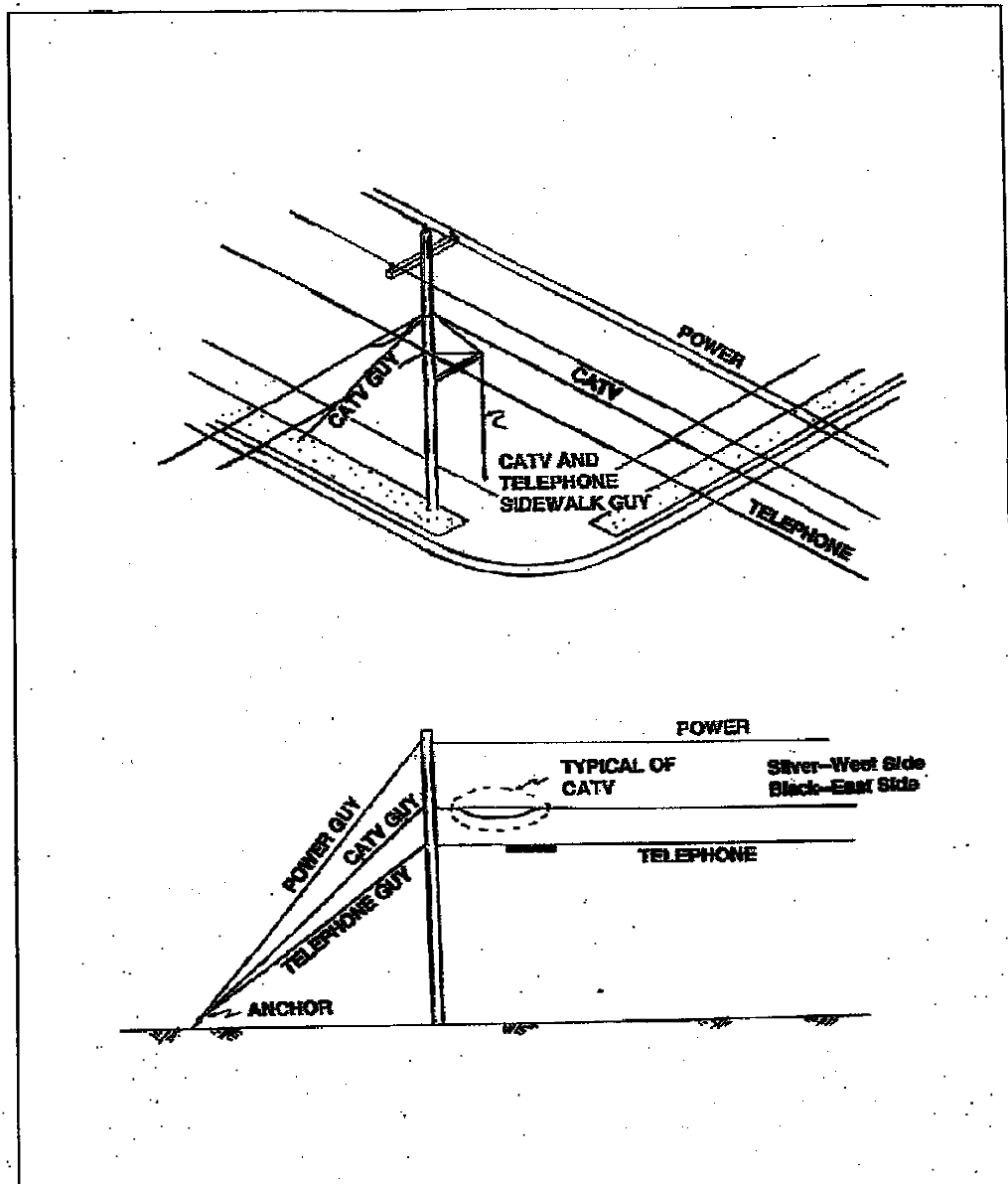


Exhibit 7-3
Typical Joint-Use Pole Installation

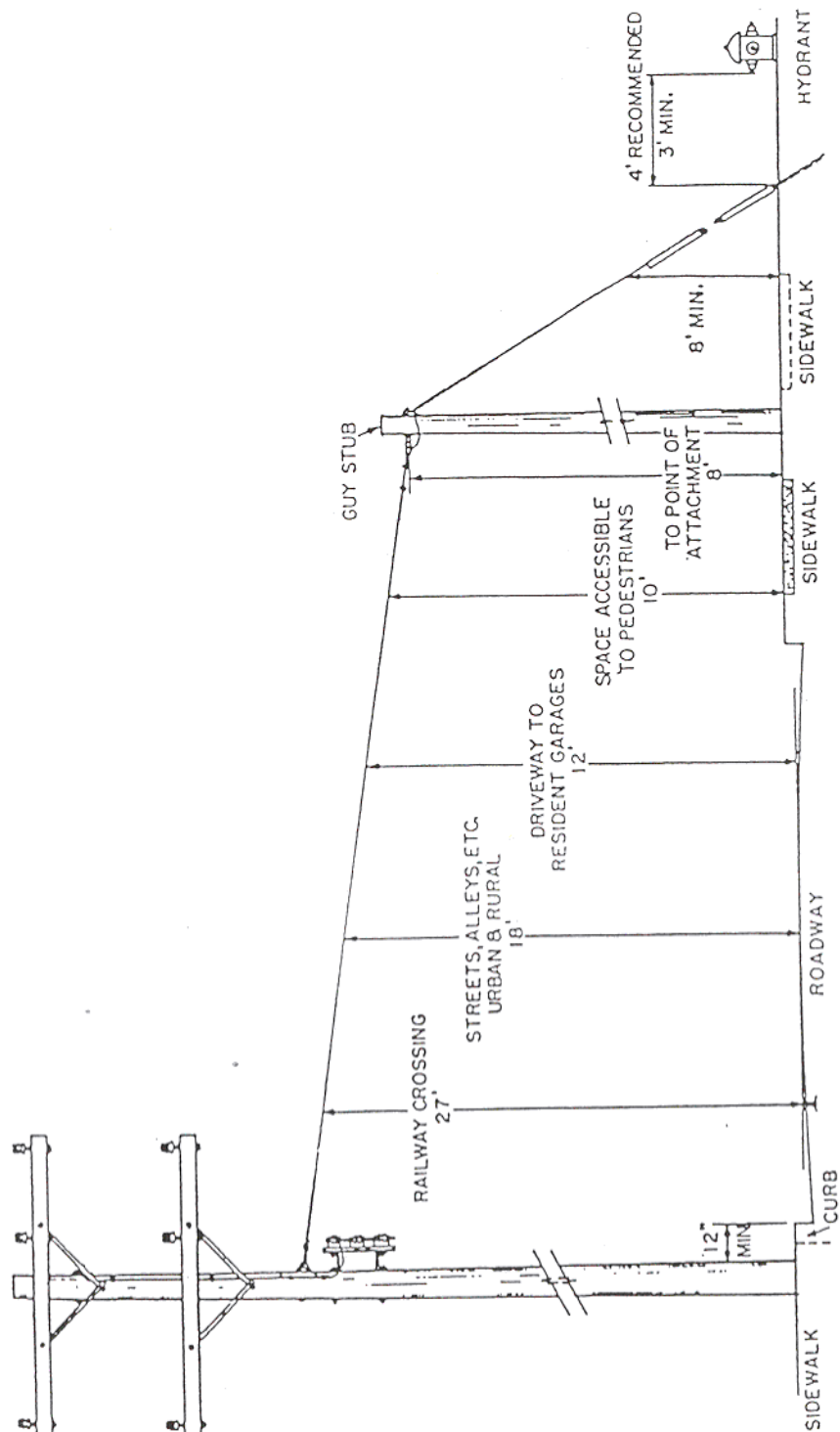


Exhibit 7-4
Typical Minimum Height Requirements for
Electric Wires and Guy Cables

- Utility cuts (street openings) on highways on the State system should be kept to a minimum in all cases where a reasonable alternate connection is available. Since State routes usually carry large volumes of traffic, economical alternatives will be considered when available.
- All traffic control devices used for the protection of work areas shall conform to and be placed in accordance with the current provisions of the national Manual on Uniform Traffic Control Devices. If a permit application for work on a State highway is judged to have a major impact on traffic, the applicant will first be referred to the appropriate State maintenance facility. This decision will be based on the duration of work and whether one or more entire lanes will be blocked. The permittee will then be required to submit a temporary traffic control plan to OSHD for approval before the City issues the permit.
- Pavement cuts must be sawcut to produce a clean, sharp edge. No drop hammers or jackhammers will be allowed unless specifically approved by the City or State.
- Trench backfill will be as specified in the current edition of the OSHD standard specifications.
- The existing pavement must be sawcut and removed 1 foot outside the ditch line on each side. The replacement paving should be of like kind and depth, with a **minimum** depth of 6" over the trench (placed in **maximum 2" lifts** compacted to current OSHD standard specifications).
- Street openings running longitudinally with the roadway and affecting the travel portions must include a 1-1/2" overlay of the roadway either half width or full width at OSHD's discretion through the affected area.

Exhibit 7-6
Criteria for Utility Cuts on State Highways

SECTION 8 - MATERIALS SAMPLING AND TESTING

The purpose of materials testing is to ensure that all materials incorporated on the project meet required standard and project specifications. The Inspector is responsible to make sure all materials whether field tested or non-field tested are properly tested and/or marked; insuring materials meet or exceed the specifications. All contracts will be Contractor quality control testing and will be used for acceptance only if verified by tests performed by an independent group, unless a visual acceptance is written in the contract.

This section describes testing requirements: types, number/frequency, procedures, and responsibilities. It should be noted that this section is confined to materials testing. Other kinds of job control checks and inspection are described in the appropriate sections of the manual (i.e., Base Construction, Concrete, Asphalt Paving, Drainage, etc).

On Permit projects, sampling and testing is usually less frequent. Depending on the size, the Inspector may need to schedule the BES materials test lab to perform some sampling and testing. If the permittee uses a private laboratory, the Inspector should monitor the testing to verify that required tests are performed.

On Contract Projects, the Contractor is responsible for all material sampling and testing according to the standard specifications for Quality Control (QC). They must follow the ODOT Manual of Field Test Procedures ("MFTP") or ODOT Non-field Tested Materials Acceptance Guide (NTMAG). The Inspector needs to coordinate with the Quality Assurance (QA) tester as required. Be sure to look in the Special Provisions under section 00165.10 to identify which type of project it is for frequency of testing.

00165.10

GENERAL GUIDELINES

In order for the testing program to be valid and objective, the following five guidelines should be carefully adhered to:

- **The sampling must be truly representative of the material to be tested.** Inspectors need to make sure that the material being delivered to the project have been tested and approved prior to placement. Verify from the tickets: Does the ticket match what has been delivered? Etc.
- **Sampling must follow proper procedures.** For example, concrete test cylinders taken from the front of the load, will likely be the wettest part of the load and the test cylinder may reflect a strength considerably less than the major part of the mixer load. Concrete should be sampled from the middle of the load. Samples of aggregate and similar materials are obtained by belt sampling at the point of manufacture, using approved AASHTO methods. Special care should be taken to ensure that the sample is not affected by the sampling method in any way that could alter the characteristics or properties of the material tested.

- **The sample must be properly identified** so that the correct tests are performed and the test results are properly identified as to material and project. At a minimum, all samples should be marked with the following items:
 1. Name of the material
 2. Source of the material
 3. Project name and number
 4. Date sampled
 5. Name of individual sampling the material
 6. Report number
- **The sample must be properly packaged, protected, and transported** to prevent damage, distortion, or contamination that might create false test results.
- **Sampling and testing must be performed expeditiously**, with adequate notice to the Contractor and testing laboratory, in order to prevent construction delays.

Testing Frequency

On any permit project, testing frequencies must be consistent with the materials testing budget. This is usually stated in the project “blue book.” Testing frequencies should be reviewed with the Field Supervisor before the project begins.

There are minimum testing frequencies for asphalt and suggested frequencies for other material testing. These are noted under the appropriate headings, below.

For Contract projects, there is a set frequency for most material tests following the ODOT MFTP. Some sampling and testing is discretionary and is based on visual observations. The Inspector should review any special testing requirements with the Construction Manager.

Notification of Test Results

On permit projects, the material testing laboratory provides reports for all test results to the Field Supervisor. If the tests reports show deficiencies, the Field Supervisor and Inspector discuss any corrections that are needed, and the Inspector then notifies the Contractor.

If any materials (e.g., pipe products, concrete mixtures, asphalt mixtures) are not properly certified and must be rejected, the Inspector should notify the Field Supervisor and the Contractor. The Inspector must inform the Contractor that the material cannot be incorporated into the project and needs to be replaced with the correctly certified and/or approved materials.

Continuing Inspection

In addition to inspecting materials before their use in the project, the Inspector should continue to observe the Contractor's operations to ensure that materials are appropriately handled and incorporated into the final product. The Inspector should watch for:

- Construction activities that could result in damage to completed areas of the work.
- The combining of materials, which might require additional sampling and testing.
- Contamination of materials, which could result in costly removal and replacement.
- Tracking of dirt or mud onto completed portions of work or to/from the worksite.

MASS GRADING AND FILLS

On private development, structural fills (embankments) are often designed and inspected by a Geotechnical Consulting firm and tested by a certified lab during construction. The required Geotechnical Field Reports are sent to Bureau of Development Services (BDS). They are also sent to the Construction Inspection Office, for review by the Manager. The City Inspector should be present, if possible, to monitor the private testing to ensure that the fill meets City Specifications for embankment in the Right-of-Way (see Section 00330.42).

The Geotechnical Consulting firm must monitor densities, compaction equipment, and moisture content during fill placement and certify the work is done correctly. The Office should be in the loop to receive copies of Geotechnical Field Reports and private test lab results on a timely basis.

In the event that the Inspector thinks construction methods or private testing is not adequate, additional testing may be ordered through the BES materials test lab. The City Geotechnical Engineer at the BES laboratory may also be consulted for advice regarding how to proceed under difficult conditions.

The Office must be notified before beginning surface removal or stripping. Subgrade should be inspected by the Inspector and approved by the Geotechnical Engineer prior to beginning placement of fills greater than two feet in depth.

On Contract projects, the Contractor must follow the ODOT "MFTP" to schedule testing during any embankment construction and document the work as required.

SUBGRADE PREPARATION

When reconstructing an existing roadway read the project specifications. Is testing required by the contractor? Does the Owner need to do QA testing? The subgrade density may be visually checked by proof rolling with a loaded dump truck. The Inspector should watch for visible deflection at the wheels. This method of testing is effective and also minimizes the potential inconvenience to homeowners. The test is done just before permission to cover with rock.

In new developments, the sub-grade density is typically checked by proof-rolling with a loaded dump truck, watching for visible deflection at the wheels. As discussed earlier, fills of 2 feet or more require a permit and testing by a certified lab during construction. Sub-grade density reports are sent to BDS and to the Office. Any compaction tests required are scheduled by the Contractor, and monitored by the Inspector, for private laboratory testing work. In the event that the Inspector thinks construction methods or private testing is not adequate, additional testing may be ordered through the BES materials test lab.

The purpose of the testing is to detect any compaction problems or density failures before the Contractor places more than a few vertical feet of fill. The results of the testing will only be accurate if the correct Proctor information is used and proper testing procedures are followed. The Inspector should coordinate with lab personnel as they take field samples. The test area(s) should be representative of the entire project, with the location(s) and elevation(s) accurately recorded by the Inspector on the daily progress report. Special tests may be required in questionable areas or in areas that have been reworked.

Laboratory field density reports should indicate the following: location (station & offset) of each test, elevation (usually referenced to the finished grade), moisture content of soil in place, optimum moisture, dry weight per cubic foot in place, and maximum standard dry density. The Office must receive the test results before the fill can be accepted.

Failures for testing compaction density during construction may be a result of:

- Excessive soil moisture or a lack of moisture content (too wet or too dry).
- A change in soil type and a resultant change in the Proctor value.
- Excessive lift thickness and/or insufficient compaction of previous lifts.
- Inadequate equipment, improper operation, or mechanical failure.
- Insufficient number of passes by the equipment.
- Poorly performed compaction tests.

DRAINAGE

All drainage products, including pipe, inlet frames and grates, and manhole frames and covers, must be certified by the manufacturer or supplier per the NFTMAG at the time of delivery to the jobsite. The Inspector must verify the certification for concrete pipe and precast manhole products by calling the BES materials testing laboratory. The Inspector should be prepared to provide:

The name of the manufacturer, the date(s) of manufacture found on the pipes and/or MH sections, the size and class of the pipe, the size and type of MH, and the test number(s) shown on the certification list. The laboratory will confirm or deny testing acceptance.

For PVC, HDPE, and Ductile iron pipe, the Inspector should verify the correct size of pipe, class of pipe, and any other identifying marks are consistent with the approved material submittal(s) and for the type of work being done.

Particular attention should be given to inspecting for damage that may have occurred in transporting the materials to the worksite. Any materials that are damaged or not approved should be rejected. Rejected material should be removed or stored in a manner so it will not be incorporated in the project.

AGGREGATE BASE CONSTRUCTION

For Contract projects, all aggregate base materials (base rock) must meet certain gradation and cleanliness specifications. On large projects, additional soundness (durability) and source compliance requirements must be met. Often, the material may be widely used and pre-approved by use on other recent projects in the City. Sometimes, the material must meet an uncommon gradation specification, a new construction method, or be from a new source or quarry.

The Contractor and/or his supplier will need to submit for approval on all sizes of base rock and other granular materials they intend to use. The Construction Manager will review them for approval. The Contractor is responsible for scheduling all sampling, testing, and providing the documentation as required in the Standard Specifications and the MFTP.

On Permit projects, testing for the compaction of aggregate base is less frequent. Testing may not be done at all, if the project is very small. If the base material looks dirty or it “pumps” when wet, then the Inspector needs to inform Contractor. A gradation, sand equivalent (SE) test, or a wash/200 test can be ordered from the BES materials testing laboratory, but the Inspector should not order tests without approval.

For all sizes of projects, visual inspection (proof-rolling) must be done to look for unacceptable deflection. Proof-rolling is an effective method for locating areas of contaminated material, soft underlying soil conditions, thin areas of base rock, poor trench compaction, or other problems. It will also provide a reality check if conditions are acceptable for the next phase(s) of work to be done, such as curb construction or base lift

paving. Usually, any soft spots found need to be dug out, a layer of sub-grade geotextile fabric installed, and new, clean base rock replaced and compacted.

If required, compaction density tests (Proctor tests) for aggregate base are scheduled by the Inspector with the BES materials lab, or by the Contractor for private lab tests. The Inspector should coordinate with laboratory personnel as they take the samples and tests in the field. Copies of all laboratory reports should be promptly forwarded to the Office.

CONCRETE

Approved Concrete Mixtures

00440, 02001

Concrete for most projects are usually supplied by local concrete plants, where mixing and batching is controlled and coordinated by the ready mix supplier. The BES materials test lab monitors and reviews them on an ongoing basis for compliance with of the Standard Construction Specifications. The lab issues an up to date list of all approved concrete mix designs from all local suppliers.

The approved concrete mixes are specified by Class, which indicates the designed compressive strength of the concrete in 28 days PSI (pounds per square inch), followed by the maximum size of aggregate to be used in the concrete (e.g., Class 3000, 1-1/2 inch).

For Contract projects, the Contractor must submit proposed concrete mixtures, for each required class of concrete, to the Construction Manager for review & approval. The Contractor is responsible for scheduling all sampling, testing, and providing all the documentation as required in the Standard Specifications. The Inspector should monitor the concrete deliveries to verify the correct class of concrete is being used and the proper documents are provided. They should also watch for proper placement methods by the Contractor.

On Permit projects, the City requires the mix design numbers on all load tickets and the batch weight information to be delivered with each load of concrete. The Inspector should verify the mix number on the ticket for the first load at the time of delivery. **If the ticket has no mix number or has a non-approved mix number, the load should be rejected.** The Inspector should periodically check other loads for proper mix information. They should also monitor the slump and visual consistency of the loads, for excessive time or addition of water to loads, and proper placement practices by the Contractor.

00440.11 &
00756.13

Slump & Air Tests

Slump tests are a quick field method to measure water content and determine the consistency and uniformity of the concrete from batch to batch.

00440.12

The Inspector can visually estimate the slump value by observing how easy or hard the concrete is to place. According to the specifications, the maximum allowable slump for most Commercial Grade Concrete is 5 inches. Some latitude may be given for weather considerations or intricate scoring patterns and for the relatively high cement content required by the City. **However, the slump must never exceed 7 inches.** Exhibit 8-3 shows how the addition of water affects concrete slump.

Entrained air tests are done to ensure the proper durability of the concrete. Most mixes will have a range from 3% to 6% of entrained air to protect it during freeze/thaw cycles.

The inspector should be familiar with concrete slump and air testing methods and observe the QCT (Qualified Concrete Technician) as the tests are performed.

As stated before, on Contract projects the Contractor is responsible for scheduling all sampling and testing, and for providing all the documentation as required in the Standard Specifications. The Inspector should be familiar with the testing methods and monitor the testing by a certified QCT to verify QC compliance. The Inspector should also track the total quantity of concrete being placed to schedule any required QA testing and for payment items.

On Permit projects, the Inspector may need to schedule the BES materials testing laboratory to conduct slump and air tests. They are normally done when casting cylinders for testing the compressive strength. The laboratory should be scheduled at least 24 hours before the desired test date, sooner if possible to avoid possible scheduling conflicts. Be prepared to give type of testing requested, the location of the job, the charge number for the project, and the number of cylinders to be cast. A private laboratory paid by the developer or Contractor may sometimes perform slump and tests and cast cylinders to test the compressive strength. The Inspector should monitor the testing to check that the tests are performed as necessary.

In very rare cases, the Inspector may be required to conduct the slump test (if the laboratory isn't available or if a batch is rejected). Exhibit 8-4 describes slump testing methods and equipment.

Cylinder Tests

Cylinder tests are used as a basis for acceptance of concrete placed. They are also valuable to the Construction Manager in assessing the consistency of the concrete mix and any variations from the normal curing curves. Cylinders of cured concrete are tested in a hydraulic press by loading under compression until failure. It is imperative that the testing and curing be done in strict compliance with AASHTO specifications, or the resultant compressive tests will not be useable. All cylinder testing must be done at a certified materials testing laboratory.

Again, on Contract projects the Contractor is responsible for scheduling all sampling and testing, and for providing all the documentation as required in the Standard Specifications. The Inspector should be familiar with the testing methods and monitor the testing by a certified QCT to verify QC compliance

For Permit projects, the Inspector needs to schedule the BES materials testing laboratory to conduct any required cylinder tests. The frequency of testing depends on the job size and type of mix (i.e., a new mix design is sampled more frequently than usual). It is preferred to have test cylinders for every two to three blocks of street. The testing should be representative to include curbs, driveways, and sidewalks if possible.

The Inspector should be familiar with the standards for cylinder preparation and should monitor the QCT to ensure test accuracy. In rare cases, the Inspector may be required to conduct cylinder tests, and should have the necessary knowledge and skills to do so.

Exhibit 8-5 provides information about cylinder casting.

ASPHALT PAVING

Approved Hot Mixed Asphalt Concrete (HMAC) Mixtures

Hot Mixed Asphalt Concrete (HMAC) for most jobs is usually supplied from local asphalt suppliers. The mixing and batching is tightly controlled and continuously tested by the supplier. The BES materials testing lab also reviews the Job Mix Formulas (JMF), monitors, and tests them for compliance with of the Standard Construction Specifications. The lab issues an up to date list of approved asphalt JMF designs from all local suppliers.

On Contract projects, the Contractor must submit proposed JMF for each required class of HMAC, to the Construction Manager for review and approval. The Contractor is responsible for scheduling all sampling and testing, and for providing all the documentation as required in the Standard Specifications. The inspector should monitor the HMAC deliveries to verify the correct JMF is being used and the proper documents are delivered.

For Permit projects, the City requires an approved JMF number on all tickets for each load of mix delivered to the job. The Inspector should check the first ticket at the beginning of a day's paving. **If a load has no JMF number on it or a non-approved JMF number, it should be rejected.** The load tickets need to be checked periodically throughout the day.

Asphalt Samples for Extraction and Rice

Asphalt Cement content, Moisture Content, Theoretical Maximum Specific Gravity and Density tests are used as a basis for acceptance of the HMAC placed. Most sampling is now done at the asphalt plant by ODOT certified technicians.

00744.16

On Contract projects, the Contractor is responsible for scheduling all sampling and testing, and for providing all the documentation as required in the Standard Specifications.

For Permit projects, the Contractor takes samples from the grade as instructed by the Inspector or a laboratory technician doing the onsite nuclear density tests. The boxes furnished by the laboratory must be filled entirely, and the test report labels must be filled out completely. The Inspector should check the temperature of the asphalt at the beginning of paving operations and each time samples are taken. The minimum and maximum acceptable temperatures for placement are 240 degrees Fahrenheit and 325 degrees Fahrenheit. This information will always be on the JMF. The samples must be transported to a materials testing laboratory for analysis.

The typical amount of samples is 3 per day for each lift of HMAC placed on the project. Some permit projects will be too small to require any sampling, but the Inspector should still verify that an approved JMF is being used and that the Contractor is following good construction practices for the transport, placement, and compaction.

Exhibit 8-7 shows the material lab test report for a HMAC sample.

Asphalt Paving Density

For Level 1, 2, & 3 mixes, the Standard Construction Specifications typically require 91 percent of the Rice Maximum Average Moving Density (MAMD) for the first or base lift of pavement, and 92 percent for any lift above the base lift. On large projects with heavy commercial traffic; it is possible to have up to 4 lifts of pavement. ONLY certified technicians from a materials testing laboratory conduct these tests since they are done with nuclear gauge with potentially harmful radiation.

00744.49
00747.49

On Contract projects, the Contractor is responsible for scheduling all sampling and testing, and for providing all the documentation as required in the Standard Specifications.

For Permit projects, the frequency of asphalt density testing should be sufficient to ensure compliance with the project specifications. Tests should be conducted frequently at the beginning of the job. Once acceptable procedures are in place, the testing frequency can be reduced.

END OF SECTION 8

NOTES

SLUMP

Aggr. Size	2"	2 1/2"	3"	4"	5"	6"
3/4"	301/36.1	306/36.7	310/37.2	319/38.3	327/39.2	333/40.0
7/8"	296/35.5	301/36.1	305/36.6	314/37.7	322/38.6	330/39.6
1"	291/34.9	296/35.5	300/36.0	309/37.1	317/38.0	327/39.2
1 1/4"	281/33.7		290/34.8	299/35.9	307/36.8	316/37.9
1 1/2"	271/32.5		280/33.6	289/34.7	297/35.6	305/36.6

Water requirement in pounds/gals per cubic yard.

Rule of thumb: one gallon will change slump approximately one inch.

Exhibit 8-3
CONCRETE SLUMP TABLE

Reprinted from *Public Works Inspector's Manual*,
Building News Book, 3055 Overland, Los Angeles, CA 90034

CONCRETE SLUMP TEST

(Reproduced through courtesy of Master Builders, Inc.)

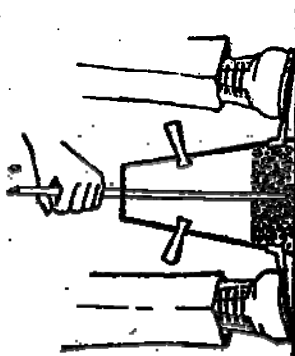
PURPOSE OF TEST: To determine the consistency of fresh concrete and to check its uniformity from batch to batch. This test is based on ASTM C 143: Standard Method of Test for Slump of Portland Cement Concrete.

Take two or more representative samples — at regularly spaced intervals — from the middle of the mixer discharge; do not take samples from beginning or end of discharge. Obtain samples within 15 minutes or less. Important: Slump test must be made within 5 minutes after taking samples.

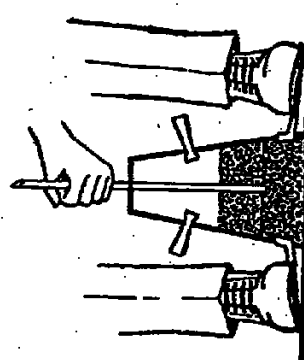
Combine samples in a wheelbarrow or appropriate container and remix before making test.

Dampen slump cone with water and place it on a flat, level, smooth, moist, non-absorbent, firm surface.

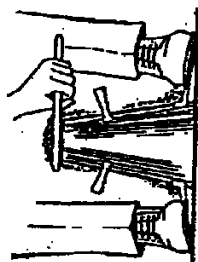
1. Stand on two foot pieces of cone to hold it firmly in place during Steps 1 through 4. Fill cone mold $\frac{1}{2}$ full by volume [$2\frac{1}{2}$ " (63.5mm) high] with the concrete sample and rod it with 25 strokes using a round, bullet-nosed steel rod of $\frac{1}{4}$ " (6mm) diameter x 24" (61mm) long. Distribute rodding strokes evenly over entire cross section of the concrete by using approximately half the strokes near the perimeter (outer edge) and then progressing spirally toward the center.



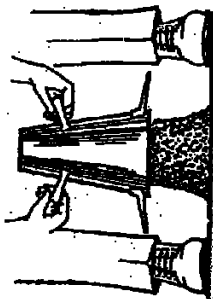
2. Fill cone $\frac{1}{2}$ full by volume [6 " (23mm) or half the height] and again rod 25 times with rod just penetrating into, but not through, the first layer. Distribute strokes evenly as described in Step 1.



3. Fill cone to overflowing and again rod 25 times with rod just penetrating into but not through the second layer. Again distribute strokes evenly.



4. Strike off excess concrete from top of cone with the steel rod, so that the cone is exactly level full. Clean the overflow away from the base of the cone mold.



5. Immediately after completion of Step 4, the operation of raising the mold shall be performed in 5 to 10 seconds by a steady upward lift with no lateral or torsional motion being imparted to the concrete. The entire operation from the start of the filling through removal of the mold shall be carried out without interruption and shall be completed within an elapsed time of $2\frac{1}{4}$ minutes.

6. Place the steel rod horizontally across the inverted mold, so the rod extends over the slumped concrete. Immediately measure the distance from bottom of the steel rod to the original center of the top of the specimen. This distance, to the nearest $\frac{1}{4}$ inch (6mm), is the slump of the concrete.

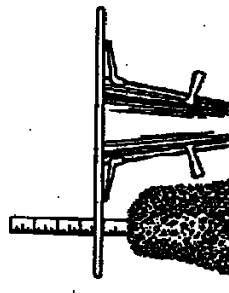


Exhibit 8-4

CONCRETE SLUMP TEST

Reprinted from *Public Works Inspector's Manual*,
Building News Book, 3055 Overland, Los Angeles, CA 90034

CYLINDER CASTING

(Reproduced through courtesy of Master Builders, Inc.)

NOTE: For complete and related procedures see ASTM Designations: C 470 Single-Use Molds for Forming 6 by 12-in. Concrete Compression Test Cylinders; C 31 Standard Method of Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field; C 94 Standard Specifications for Ready Mixed Concrete; and C 172 Standard Method of Sampling Fresh Concrete.



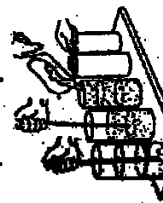
USE ONLY NON-ABSORBENT WATERPROOF MOLDS

For casting concrete cylinders in the field, use only approved non-absorbent waterproof molds, 6" (15 cm) in diameter by 12" (30 cm) high, with base plates or bottoms. They should be placed on a smooth, firm, level surface for filling and cast in the area where they are to be stored during the first 24 hours and where they will be protected from vibration, jarring, striking, etc.



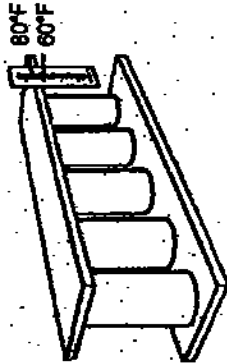
TAKE 3-PART SAMPLE; COMBINE AND REMIX

Three samples of the concrete should be obtained, at regularly spaced intervals, directly from the mixer discharge. Combine the samples in a wheelbarrow, buggy or metal pan and remix with a shovel to ensure uniformity of the 3-part sample.



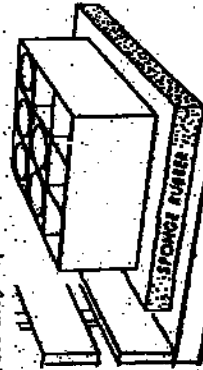
FILL MOLDS IN THREE EQUAL LAYERS AND ROD EACH LAYER 25 TIMES

Fill molds in three equal layers and uniformly rod each layer 25 times with a 3/8" bullet-rod. When rodding the second and third layers, the rod should just break through into the layer beneath. Fill all molds uniformly — that is, place and rod the bottom layer in all cylinders, then place and rod the second layer, etc. The third layer should contain an excess amount of concrete which is struck off smooth and level after rodding.



PROTECT CYLINDERS FROM MOISTURE LOSS, MOVEMENT AND TEMPERATURE EXTREMES

Cover the tops of the cylinders to prevent loss of moisture by evaporation. Do not disturb or move cylinders for 24 hours after casting. Protect them against temperatures that fall below 60°F (16°C) or exceed 90°F (27°C). Cylinders left on the job for several days and exposed to high or low temperatures will give substandard results. Additional cylinders used for determining when forms may be stripped or when concrete may be put into service should be removed from the molds after 24 hours and then job-cured adjacent to and under the same conditions as the concrete they represent.



CURE AND HANDLE CYLINDERS WITH CARE

After 24 hours, cylinders for acceptance tests should be placed in moist curing at 73.4°F ± 3°F (23 ± 1.7°C) or sent to a laboratory for similar standard curing. Careful handling during moving is necessary since cylinders which are allowed to rattle around in a box, at the back of a car, or pick-up truck, can suffer considerable damage.

IMPORTANT

ALWAYS USE ACCEPTED STANDARDS — Standard test procedures were developed to establish lines of uniformity and reproducibility. Only specimens tested according to accepted, reliable standards, such as those established by the American Society for Testing and Materials, give valuable indications of the uniformity and potential quality of the concrete in a structure.

Exhibit 8-5
CYLINDER CASTING

Reprinted from *Public Works Inspector's Manual*,
Building News Book, 3055 Overland, Los Angeles, CA 90034

**ASPHALT CONTENT by IGNITION METHOD (BURN-OFF) & GRADATION
& MAXIMUM UNIT WEIGHT of
BITUMINOUS MIXTURES**

**AASHTO
TF 53**

CITY OF PORTLAND
BUREAU OF ENVIRONMENTAL SERVICES
MATERIALS TESTING LABORATORY

REPORT NO. 8330
DATE RECEIVED 1-23-01
LAB TAG NO. (22)

SAMPLE DATA

BUREAU BTE CC CC JOB NO. 42995
PROJECT SE 137th & Ellis SAMPLED BY Contractor
CONTRACTOR Bellamy & Son INSPECTOR J. Loya
SUPPLIER Pac Rock PLANT LOCATION
TYPE OR CLASS C MIX NUMBER Comm C ASPHALT TEMP DATE PAVED 1-23-01

USE: ☐ HIT BASE ☐ BASE ☒ TOP ☐ SEWER CUT ☐ UTILITY CUT ☐ PATCHING

WEATHER Overcast, windy TEMP TIME 11:45

LOCATION (STREET) SE 137th Ave STATION at iv. PC near

TEST REQUESTED: ☒ AC CONTENT & GRADATION ☒ MAXIMUM UNIT WEIGHT

LABORATORY REPORT

TESTED BY TT DATE 1-24-01 CHECKED BY NB DATE 2/2/01

SIEVE	ACCUM. RETAINED	PASSING	SPEC	FORMULA	TOLERANCE	MOISTURE CONTENT
SIZE	WT (g)	(%)	(%)			
1"						WET WT w/TARE <u>1323.0</u> g
3/4"	<u>0</u>	<u>0</u>	<u>100</u>	<u>100</u>	<u>95-100</u>	DRY WT w/TARE <u>1325.2</u> g
1/2"	<u>68.8</u>	<u>5</u>	<u>95</u>	<u>94</u>	<u>90-100</u>	TARE <u>203.7</u> g
3/8"	<u>289.4</u>	<u>19</u>	<u>81</u>	<u>-</u>	<u>-</u>	WET WT <u>1123.3</u> g
1/4"	<u>522.3</u>	<u>38</u>	<u>62</u>	<u>61</u>	<u>56-66</u>	WATER WT <u>1.8</u> g
#4	<u>689.5</u>	<u>40</u>	<u>54</u>	<u>-</u>	<u>-</u>	% WET
#10	<u>934.3</u>	<u>60</u>	<u>34</u>	<u>33</u>	<u>29-37</u>	MOIST CONT = <u>0.16</u> %
#40	<u>1252.1</u>	<u>85</u>	<u>15</u>	<u>15</u>	<u>11-19</u>	
#200	<u>1417.1</u>	<u>94.5</u>	<u>5.5</u>	<u>5.1</u>	<u>3.1-2.1</u>	INITIAL w/TARE <u>9221.9</u> g
PAN	<u>1428.7</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	- TARE <u>6123.0</u> g
AC	<u>-</u>	<u>5.4</u>	<u>5.5</u>	<u>5.0-6.0</u>	<u>-</u>	= INITIAL <u>1598.1</u> g
(WT. LOSS/INITIAL) x 100 =						BURNED w/TARE <u>7623.1</u> g
LOSS% <u>6.13</u> %						- TARE <u>6123.0</u> g
- MOIST <u>0.16</u> %						= BURNED <u>1500.1</u> g
- CF <u>0.62</u> %						(BURNED = Gradation Total Wt.)
= AC% <u>5.4</u> %						INITIAL - BURNED
WASHED AGG (W.A.) OVEN DRIED						= WT. LOSS <u>98.0</u> g
W.A. w/TARE <u>3180.7</u> g						Maximum Density
- TARE <u>1751.6</u> g						(RICE, from Worksheet)
= W.A. <u>1429.1</u> g						<u>155.8</u> pcf
BURNED - W.A. = WASH LOSS						
WASH LOSS <u>71.0</u> g						

REMARKS

Circle one: PASS FAIL

Laboratory Supervisor NB Date 2/2/01

ORIG TO: MTL AC FILE
COPY TO: BTE - S. Thomas
FAX TO: 2-5

PRINTED 12/13/2000

Exhibit 8-7

ADDITIONAL TEST DATA

SECTION 9 - SUBGRADE PREPARATION

GENERAL

Various earthwork operations are done to prepare the sub-grade to act as an acceptable, stable foundation for all aspects of street construction. Inadequate sub-grade preparation can result in failure of the street structure and subsequent maintenance problems. The conditions and requirements of each project will vary due to terrain, soil conditions, and expected traffic use.

It is important that the Inspector be on the site to perform visual inspections, take measurements, and coordinate testing to determine the adequacy of the work. Frequent observation of the equipment and methods used by the Contractor should be made in the initial stages of work. Once the most appropriate methods and equipment are established, the Contractor should continue to use them throughout the project.

The Inspector is responsible for understanding the requirements and tolerances within the specifications for each project and for having enough knowledge to be able to interpret this information during inspection.

Site Examination before Subgrade Preparation

Prior to sub-grade preparation the Inspector should examine the site with the Contractor. The following conditions should be reviewed:

- The erosion control plan and measures need to be in place before breaking ground.
- Any manholes, vaults, or other structures located within the project should be identified, found, locations recorded, and well marked to prevent construction damage and/or avoid accidental burial.
- The storm and sewer manholes should be examined for any existing damages.
- All valves to operate the water system must be protected and remain accessible at all times for emergency shut-off.
- The limits of any grading, excavation, or other work behind the R.O.W. line, such as walls, driveways and lawn walks identified and discussed.
- The survey-staking schedule and plan for providing adequate control.
- Check that access to driveways is provided, and traffic signs are protected.

Survey Staking and Control

00150.15

Line and grade survey stakes should be preserved during all sub-grade preparation operations. The Inspector should check the line (alignment), elevation, and cross-section of the sub-grade in accordance with the grade stakes set by the survey crew. Most grade checking is done with a string line and pocket rule. It is appropriate to have one or more of the Contractor's crew (when available) to assist with holding the line taut. This has the added benefit of alerting the Contractor to any deficiencies in the sub-grade preparation.

Hand level checks can be used for rough grading, but not for approving final grade. If hand levels are used, the reference line calculations should be checked at several stakes to ensure accuracy.

SUBGRADE CONSTRUCTION

Clearing and Grubbing Operations

Clearing and grubbing operations are done to remove all types of vegetation (trees, brush, roots), and other debris. The topsoil layer is usually stockpiled for later use in landscaping or other areas where select native material is needed.

00320

Any structures, fences, concrete, pavement, or other man-made materials to be removed is considered to be removal of structures and obstructions.

00310

All debris collected during clearing and grubbing should be disposed of as specified, before any other grading operations commence. The Inspector should be aware of any piles of debris that could potentially be covered up by large earthwork machinery.

Any trees, shrubs, structures, or other improvements to remain should be noted on the plans, and the Inspector should see that the Contractor protects these items from construction operations and equipment damage.

- *Existing trees* that are to remain must be protected, as specified in the Standard specifications. Their roots must also be protected and can only be trimmed after inspection and permission from the Urban Forestry Division of the Bureau of Parks.
- *Tree removal and salvage* in the street right-of-way requires that the Contractor notify adjacent property owners of the felling and of their rights to the wood from the felled trees. Property owners have 7 days after felling to remove the timber.
- *Tree trimming* operations should be performed as outlined in the Standard specifications and as approved by the Urban Forestry Division of the Park Bureau. Trees should have 8-foot of vertical clearance over sidewalks and a 20-foot clearance over streets.

00320.40(b)

00320.40(c)

00320.40(b)

Visual Inspection after Clearing and Grubbing

After clearing and grubbing, the Inspector should visit the job to make a visual inspection of the surface. Any of the following conditions should be reported immediately to the Field Supervisor or Construction Manager:

- Slippage planes.
- Soft or water-saturated material.
- Highly organic "Blue gumbo" soils.
- Unconsolidated fill.
- Buried debris or contamination.
- Peat deposits.
- High water table or visible seepage.
- Abandoned tunnels or large conduits.

Mass Grading and Fills

On certain hillside subdivisions and large industrial projects, the mass grading work for the entire site is often done prior to issuance of the street permit. A grading permit is issued by the Bureau of Development Services (BDS) and must be approved by PBOT. Since any fills in the Right-of-Way will eventually support our roadways, the embankment needs to be inspected, tested and certified as being structurally sound.

A pre-construction meeting should be held prior to construction to explain the Inspector's role and expectations to the Contractor and the Geotechnical Engineer. The Inspector will need the grading plans and the preliminary street plan and profile in order to monitor the work properly. The street plan should show street names, stations, and general layout.

BDS has limits on the amount of earthwork that can be done during wet winter months. The Inspector should monitor the site to see that erosion control measures are in place and working effectively and that no measurable erosion is leaving the site.

EARTHWORK

Excavation

Excavation for each project differs in the type of equipment used, safety requirements, and methods employed. Excavations at a project site are classified under one or more of the following categories:

- *Rock Excavation*
Rock excavation is the removal of material that is systematically drilled and blasted or broken by power-operated tools designed for rock excavation. The term "rock excavation" refers to the type of removal, not a geologic formation. **00330**
- *Common Excavation*
This includes any excavation that is not defined in the specifications as rock or concrete excavation. It can include rock, concrete, etc., if a separate bid item is not established. **00330**
- *Concrete Excavation*
This includes the excavation and removal of all concrete material with or without reinforcement, when specified as a bid item. **00310**

Inspectors should be aware of how excavation and embankment quantities are calculated. Excavated soils increase in volume, while compacted soils decrease in volume (due to increased density). This is known as swelling and shrinkage, respectively. It is important to note when excavation is considered incidental to other items of work (i.e., excavation to form concrete, volume displaced by new concrete, etc.). **00330.80**

Soil concerns during excavation include lateral stability properties, water-saturated soils, and unstable soils. In addition, the presence of rock, boulders, or hardpan soils increase the difficulty of excavation and may require the use of larger, specialized equipment to overcome the problems.

Disposal of excavated soils that are not suitable or required for backfill are the responsibility of the Contractor. The Inspector should be aware of the Contractor's methods and locations of disposal to ensure compliance with local jurisdictions. A fill permit is typically required to dispose of more than 50 cubic yards of material on private property. The Inspector should notify the Field Supervisor or Construction Manager if they doubt the validity of the Contractor's disposal method. **00330.41(a) 5**

Embankment

Embankment is the term used to describe the construction operation of placing, preparing, and compacting fill material to a specified elevation. All excavation operations should be performed, sub-drains installed (when required), and the sub-grade proof-rolled prior to beginning embankment construction.

Fill material is placed in thin lifts and compacted. Fills should be placed on sound foundation soils in level planes. On sloping ground, benches must be cut into the existing slope as a slope fill is constructed. The best possible interlock between the original ground and the new fill material should always be obtained. (See Exhibit9-1)

The following outlines the procedure for embankment construction:

00330.42

- *Scarify* the foundation surface to a depth of 12-inches.
- *Control moisture content* to within -4% to $+2\%$ of the optimum for the material.
- *Compact with appropriate equipment* to achieve the specified density.
- *Begin placement and compaction* of material in thin lifts to reach final grade.

00330.43

Compaction

Compaction of the sub-grade increases the strength and load-bearing ability of the soil and decreases the cost of the structural section, the possibility of future settlement, and maintenance. The smoothness of the completed sub-grade is important and has a direct effect on the outcome and appearance of the final pavement surface, especially HMA pavement laid by a mechanical paving machine.

00330.43

Compaction operations should result in the following two characteristics within the fill material:

- The final density meets the specifications with no deflection.
- The required degree of uniformity is reached.

The Inspector needs to be familiar with both compaction equipment and methods, as there is a wide variety of each used to achieve the specified compaction requirement. The principal factors and variables in compaction are the:

- ***Size of the area***
This will partially determine the type of equipment used.

- ***Type of soil***
Soils vary in the amount of compaction needed. Granular soils are most effectively compacted by vibration, sometimes in combination with heavy weight. Clay soils are responsive to added weight and are readily compacted with a "sheepsfoot" or other tamping rollers. The Inspector should be on the lookout for large stones, organic material, and changes in soil type. See Exhibit 9-2 for information on types of soils and recommended compaction equipment.
- ***Amount of moisture present***
Uniform compaction is dependent on the even distribution of moisture throughout the soil. The Inspector should be able to review the optimum moisture values for type of soils involved from the project specifications. Frequent spot checks, examining handfuls of soil and observing equipment movement over the soil, will help the Inspector in determining the moisture content.
- ***Thickness of the lifts***
The maximum depth of each lift is 8 inches (unless testing indicates results can be obtained with thicker lifts). If the specified compaction is not being obtained, the thickness of each lift should be reduced. 00330.42
- ***Type of equipment***
Tamping rollers are the most commonly used equipment. Satisfactory results can be obtained with a greater range of moisture content over and under the optimum. If a lift is too dry, a tamping roller will quickly "walk out," indicating a problem in the fill material. If smooth drum rollers are used, make sure the surface of each lift is scarified prior to placing the next. See Exhibit 9-3 for more information on compaction equipment.
- ***Number of passes by the equipment on each lift***
The number of passes required will be determined by the thickness of the lift, the size, and the type of equipment used. In general, the thicker the lift, the more passes are required to reach the specified density. The Inspector should check to make sure the operators are making the required number of passes determined to be necessary.

Some compaction will take place due to the heavy equipment and vehicles traveling over the area. The Inspector should remind the Contractor to avoid damaging the sub-grade and have vehicles distribute their travel routes over the entire area, as much as possible.

MATERIALS SAMPLING AND TESTING

Testing for sub-grade density may only require visual inspection by proof rolling (deflection test) for acceptance by the Inspector on small projects. On large projects and developments, compaction testing will normally be required. Detailed information is included in Section 8: SUBGRADE PREPARATION.

**See
Section 8**

Ongoing Inspection

Throughout sub-grade construction the Inspector should:

- Check that the Contractor continues to use the appropriate methods and equipment.
- Anticipate problems by keeping ahead of the work being performed and observing the general direction of the construction in progress.
- Record all locations of soft spots discovered during proof-rolling and verify corrections are properly made.
- Check to make sure that the area is not being over-excavated; slope limits are being adhered to, proper compaction is being achieved, etc.
- After the sub-grade has been tested for specified densities, ensure that the Contractor protects the sub-grade from damage until it is covered with a base course or pavement.

00330.40(c)

SUBGRADE STABILIZATION

Foundation Stabilization

00331

Foundation stabilization may be required when the native material in the bottom of the excavation is unsuitable for supporting street construction and cannot be corrected by moisture conditioning. The material is removed by over-excavating any soft areas in the roadbed and then backfilled with suitable native (or imported material). The backfill must be compacted in layers to meet specified densities. The Inspector should be present to observe the general excavation to determine if any removal of unsuitable sub-grade soil is necessary.

Soil Stabilization

Soil stabilization is another method used to improve weak sub-grade soils that may not otherwise support surface improvements. It is also done as a cost saving strategy to reduce the thickness of the aggregate base course and HMA section.

When soil stabilization is specified, the following methods have been used.

- **Cement treated soil** involves mixing cement with soil usually by spreading it on the soil, roto-tilling it into the top several inches, and then rolling the mixture with adequate moisture. After application, the surface is generally sealed with emulsified asphalt to preserve moisture and is protected from traffic for 72 hours.

- **Cement treated soil** should not be done before all underground utilities are in place. If trenches are dug into the Cement treated sub-grade, trench restoration usually requires the backfill must be granular material or an approved equal replacement for the Cement treated soil section.
- **Lime treated soil** consists of stabilizing sub-grade soils with a lime treatment, applied in a dry form or as slurry from a tanker truck. The soil must be tested for compatibility with the lime. After application, the surface is generally sealed with emulsified asphalt to cure and is protected from traffic for 72 hours.

Geo-synthetic Fabrics

Fabrics are now commonly used in street construction for sub-grade stabilization, for drainage behind retaining walls and in pipe trenches, and as silt fences for erosion control. Most products are made of polyester or polypropylene materials. They vary in mesh size and design and may be permeable or impermeable. It is important that these fabrics are handled carefully to avoid tearing or puncturing. They must also be protected from ultraviolet (UV) rays. 00350

Geotextiles (permeable fabrics) are popular for use in construction on unstable foundations. These fabrics are manufactured to permit slow migration of water while restraining fine-grained soil particles. When placed on unstable surfaces, the fabric tends to prevent rotational failure and minimizes lateral sliding. 00350

When placing fabric on any sub-grade, the fabric is unrolled directly on the area that has been cleared, properly graded, and prepared for base rock. 00350.41
The fabric is aligned and pulled taut, and the edges typically overlapped 24 inches. A minimum of 6 inches of aggregate material is placed to cover and protect the fabric. The aggregate should be back dumped and pushed with a dozer to prevent trucks from driving directly on the material. The aggregate should be spread in the same direction as the fabric overlaps to avoid separating the fabric at the overlaps.

EROSION CONTROL

00280

The project site and any affected adjacent properties must be protected against erosion. Erosion control work is performed with a variety of methods and devices, including temporary seeding for vegetative slope stabilization, straw bales, silt fences, settling basins, and retention basins. An erosion control plan will be included in the construction documents. It should identify the temporary and permanent erosion control Best Management Practices (BMP) techniques and devices to be used.

The Inspector is responsible to check that the Contractor is implementing erosion control measures. That the required BMP's are installed correctly and working effectively.

00340 &
00220.60

This includes that dust control measures are in effect, if necessary, whenever earthwork operations are being performed including sprinkling and sweeping. The Inspector should notify the Field Supervisor and the Construction Manager if the contractor deviates from the approved plans or when measurable amounts of soil are observed leaving the project site.

See also Erosion Control Guidelines in Erosion and Sediment Control Manual. Projects now require an erosion control sign with a hotline number on it for reporting problems or concerns. It must be visible at all times for the duration of the project.

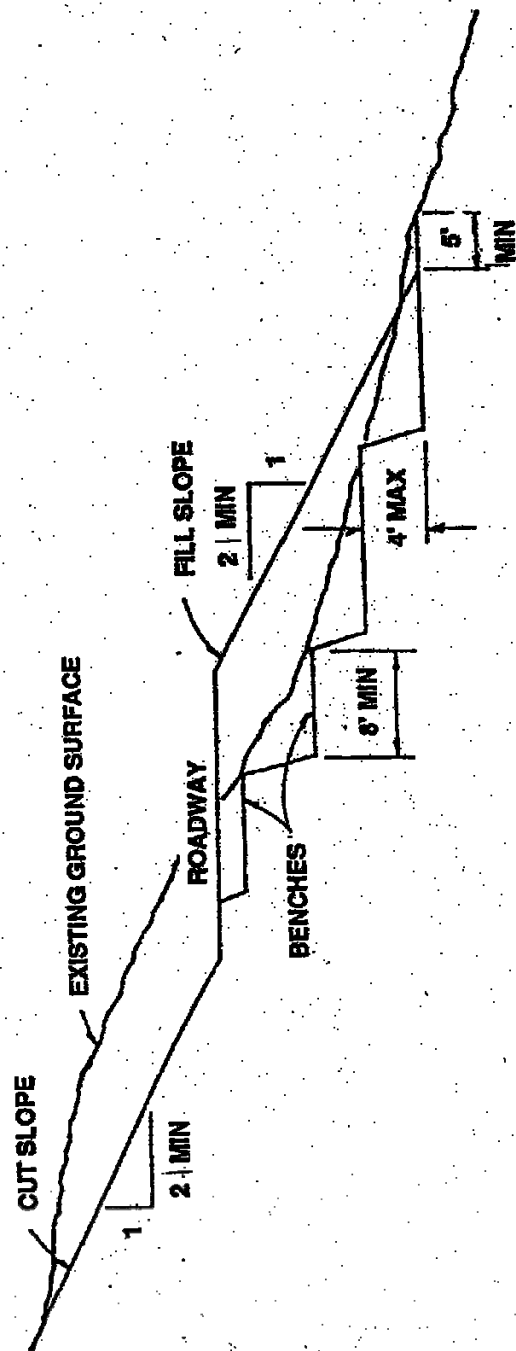
END OF SECTION 9

SUBGRADE PREPARATION INSPECTOR'S CHECKLIST

- Verify that the Contractor has installed all required erosion control BMP.
- Check to see that the Contractor is following appropriate public safety methods, such as protective covers, fences, barricades, lighting, warning devices, signs, etc.
- Check tree and shrub preservation or removal. Grubbing operations should remove all tree stumps and roots in the entire Right of Way.
- Ensure that the property owner is aware of tree and shrub removal and has been notified of his salvage rights to any wood.
- Determine where excavated material is being disposed of. If on private property, ask to see necessary fill permits. If the Contractor has none, notify the Bureau of Development Services (BDS) through the Field Supervisor, Manager, or Construction Manager.
- Request the Contractor to retain select backfill material for backfilling curbs and parking strips.
- Check if excavation and embankment clearances are adequate for construction activities.
- Check for seepage and other latent conditions that might affect the foundation of the fill.
- Note any unusual soil conditions. Have organic and unsuitable soils been removed? Report any unsuitable sub-grade conditions to the Field Supervisor or Construction Manager.
- Monitor that the Contractor is using appropriate equipment and methods consistently throughout the project.
- Verify that the appropriate testing is being performed and recorded, if required.
- Verify that the foundation is prepared prior to embankment construction. Are benches cut into existing slopes to tie into the new fill?
- Require that the best material from excavations be used for embankment. Watch for changes in the fill material.
- Verify that embankment has been performed in required lifts and compacted as specified.

- Note any excessive deflections under equipment loads. Is the entire area receiving equal effort?
- Observe the earth under the roller for movement and signs of excess moisture. Have the Contractor rip and aerate, if necessary.
- Check to see that the Contractor does not unnecessarily over-excavate the sub-grade.
- Inform the Construction Manager of any over-excavation necessary to remove unsuitable material.
- Ensure that drainage is continuously provided as sub-grade preparation progresses. Are dewatering methods in operation? Are ditches maintained?
- Continue to monitor erosion control measures and their effectiveness.
- When sub-grade preparation is complete, check to make sure that upstream inlets are open to minimize potential rain damage and the sub-grade is protected until base courses are placed.
- Check the sub-grade with a string line before approving cover with base rock. Check at a minimum of 100-foot intervals and report findings in daily progress report and to the Contractor.
- Check inlet weep holes to make sure they are clear of obstructions and are not allowing aggregate, dirt, or sand to fill the structure or inlet leads. Try to keep weep holes open until project is paved.

NOTES



TYPICAL DETAIL FOR FILLING ON EXISTING SLOPES
GREATER THAN 5 HORIZONTAL TO 1 VERTICAL

Exhibit 9-1
 FILLING ON EXISTING SLOPES

Types of Soils and Recommended Compacting Equipment

Materials	Type of Compaction Equipment
Fine-grained embankment and subgrade soils	Sheepsfoot rollers Segmented steel-wheeled rollers Pneumatic-tired rollers Vibratory steel-wheeled rollers
Granular base, subbase and improved subgrade courses	Pneumatic-tired rollers Vibratory compactors (both shoe and steel-wheeled type) Segmented steel-wheeled rollers
Coarse aggregate base courses	Shoe-type vibratory compactors Steel-wheeled vibratory rollers Steel-wheeled rollers Pneumatic-tired rollers
Plant-mix base, leveling or surface courses	Breakdown rolling: Steel-wheeled three-wheel rollers Steel-wheeled rollers (two-axle tandem rollers) Intermediate rolling: Pneumatic-tired rollers (self-propelled) Two-and three-axle tandem rollers Final rolling: Steel-wheeled rollers (two-or three-axle tandem rollers)

Exhibit 9-2 RECOMMENDED COMPACTING EQUIPMENT

Reprinted from *Public Works Inspector's Manual*,
Building News Book, 3055 Overland Avenue, Los Angeles, CA 90034

Types of Rollers and their Recommended Uses

Roller Type	Weight in Tons	Recommended Lift Thickness (Loose In.) for 8 Passes		Operating Speed (M.P.H.)	Most Suitable Soil Type
		Lighter Units	Heavier Units		
Pneumatic	3-12	4-6	6-8	1-15	Sandy, sandy clay, silts
Super- compactors	20-50	12-18	12-24	5-10	All types
Tamping (sheepsfoot)	2-20	6-8	8-12	5-10	Clay and silty clays
Tandem (2-axle)	3-16	4-6	6-8	1-5	Granular, particularly where crushing is desirable
Tandem (3 axle)	12-20	4-6	6-8	1-5	
Three Wheel	5-20	4-6	6-8	1-5	

Exhibit 9-3 TYPES OF ROLLERS

Reprinted from *Public Works Inspector's Manual*,
Building News Book, 3055 Overland, Los Angeles, CA 90034

SECTION 10 - DRAINAGE

GENERAL

Drainage is critical because of the damage water can do to street improvements if not properly controlled and transported into a collection system. Street construction includes storm drain systems to collect and control surface runoff from rainfall and other sources of water.

There are three types of systems designed to handle storm drainage in the City of Portland. In most areas, runoff is collected and then transported to a storm sewer system. In some areas of the City, where soil conditions allow, storm water may be collected and distributed to a sedimentation manhole and then into a sump, or series of sumps, for dispersal into the ground, more frequently runoff is collected into a water quality facility.

The street Inspector is primarily responsible for inspecting storm inlets. He may also inspect the installation of sumps and sedimentation manholes. In addition, he may inspect any sub-drain installations or culvert replacements that are part of the project requirements.

In new construction, the Bureau of Environmental Services (BES) generally inspects all storm pipe installations and storm manholes, and water quality facilities. Street Inspectors are responsible for inspecting the storm inlets, curb/wall alignment/elevation for water quality facilities. On rare occasions, the Inspector may inspect the entire system on small projects.

MATERIALS SAMPLING AND TESTING

All drain pipe, pre-cast manholes, manhole frames and covers, and inlet frames and grates need to meet the City Standard construction specifications. Inspectors are responsible for verifying that these items have proper certification prior to installation. This information was previously discussed in Section 8-DRAINAGE.

00445

The BES Inspector will observe and approve any air tests or other pipe testing required for the storm drainage system.

00445.72

MATERIALS USED IN DRAINAGE SYSTEMS

Pipe

All pre-cast concrete pipe used in constructing drainage systems is tested and approved by the City BES test laboratory. The quality and consistency of the concrete and curing process affects the durability of the pipe and its life expectancy

00445.10

in use. Pre-approval of the pipe ensures that the pipe is uniformly produced and will meet the specifications when it is delivered to the jobsite. The Inspector is responsible for checking and verifying dates and certification numbers with the materials testing laboratory before any pipe is installed.

- *Reinforced concrete pipe* is available for a wide variety of pressure and non pressure classes and in both standard and custom sizes. A large variety of joint configurations are possible; however, bell and spigot joints are commonly used for storm drain pipelines.
- *Un-reinforced concrete pipe* is cast in vertical molds, usually in sizes of 21" diameter or less, and is of the bell and spigot type. This pipe is generally used under light loading conditions only.
- *HDPE (High Density Polyethylene Pipe)* smooth, thick-walled, slightly flexible, black plastic pipe approved for storm drain systems. Look for 10-inch minimum diameter, SDR 26, PE 3408 on the side of the pipe.

In some cases when utility conflicts are encountered, the proper depth for inlet pipe may not be possible. The Construction Manager may require the use of ductile iron piping, heavier walled HDPE, or concrete encasing of the concrete pipe to ensure that the pipe will not fail under truck or bus loading in shallow situations.

Drainage Structures

The Inspector is responsible for verifying that these items have proper certification prior to installation. Additional information was discussed in Section 8:

- *Inlets* are one type of receptacle used to transmit surface water into a storm drain system. They are constructed in place, to the sizes and shapes shown by the plans (as specified by BES), and cannot be changed without approval. See RD364 and RD366 in the Standard Construction Drawings for the various types of inlets. 00470
- *Precast Inlets* are not allowed in the roadway. They do not work well in front of driveways, wheelchair ramps or wings, small radius corners, or on steep hills. They often do not meet the City specifications for strength or wall thickness, especially if they have pipe cutouts.
- *Grates* for inlet openings (or any other similar perpendicular opening in street improvement projects) must be bicycle safe or modified to be bicycle safe by adding steel straps. RD364, RD366 & RD372 in the Standard Construction Drawings show the approved bicycle-safe grates for new storm inlets. Special care should be taken to ensure that the inlet frame ledge angle is parallel to the curb.

The Inspector should be aware of the configurations for bicycle-safe grates and notify the Contractor if grates are not in compliance.

- *Manholes* permit access to the system for inspection and maintenance. Most manholes are pre-cast and installed in sections. The base can be poured in place or pre-cast with a subsequently poured channel. The maximum distance from the top of the manhole cover to the first step is 26", as per Standard Plan P-150.
- *Slotted or perforated drainpipe* may be installed within saturated areas of the prepared sub-grade to collect seepage and prevent it from undermining surface improvements. These sub-drains usually include open graded drain rock and filter fabric. **00430**
- *Trench backfill material* for all pipe trenches in the street area must be an approved granular material. Native backfill material is very rarely used and ONLY with the approval of the Construction Manager. **00405**

STORM DRAINAGE CONSTRUCTION

Inlet Structures

470.43

Cast-in-place concrete storm inlets should conform to the requirements in the Standard Construction Specifications. The interior of all cast structures should be free of projections, rough form texture, or other irregularities that increase friction and reduce the conduit efficiency. The floors should be constructed with a slight slope to the outlet pipe. Avoid sumps in bottoms of inlets unless specifically required on plans. Weep holes should be positioned near the street sub-grade elevation and protected so they do not allow aggregate, dirt, and sand to enter the inlet and inlet leads. (This is usually done with fabric or course gravel.)

The depth of these structures from the top of the curb to the invert of the outlet pipe is indicated on the Standard Plans. The minimum depth is typically 30 inches, but the depth should not exceed 48" depth without approval.

In some cases, inlet piping may be connected directly to an existing large-diameter pipe rather than routed to a manhole. This is only done if approved by BES or shown on the approved plans. The Inspector should consult the Field Supervisor before inspecting this type of work.

Trench Excavation

00405.41(c)

The Inspector should review existing site conditions and the maximum trench width of the excavations with the Contractor. During trenching operations, the Inspector should be alert to detect any settlement of adjacent improvements, and should carefully record any damage that occurs.

The Inspector should check to see that the trench is centered on the plan line and that minimum side clearances are maintained. Also, the trench width should not be exceeded to avoid pipe failure caused by excessive backfill loading. Loose material in the bottom of the trench should be removed before pipe bedding is placed. The bedding should conform to project specifications and BES Standard Plan P-101 or ODOTRD300.

The Contractor is responsible for following OSHA safety standards when trench excavation and shoring is undertaken. The Inspector should be able to recognize any unsafe condition that may evolve during trenching operations. Any potentially dangerous situation should be brought immediately to the Contractor's attention.

00405.41

If additional information on OSHA standards is needed, check with the Office.

Sub drains

Sub drains may be required and usually consist of slotted or perforated pipe in a trench filled with drain rock. When the pipe is installed, it should be laid with the perforations turned down and the pipe surrounded by an open-graded gravel for proper drainage. The pipe and drain rock are often wrapped in a filter fabric blanket.

Laying Pipe

00445.43

The Inspector should examine all concrete pipe delivered to the jobsite for any damage that might have occurred in transport. The pipe should be carefully handled and not be dropped or rolled against other pipe. Any pipe that shows cracks or other substantial damage must be rejected.

Laying pipe should be performed so that a smooth flow line is maintained with bells upstream. Pipe bends are only allowed under special circumstances. It is preferable to install sweeping curves rather than sharp bends in order to facilitate sewer equipment and maintenance operations. On long radius curves, "pulled joints" may be used, IF within the joint gap tolerances permitted by the specifications. Shorter lengths and mitered pipe may be necessary for short radius curves. The common method for maintaining line and grade is with electronic laser equipment. See Exhibits 10-1 through 10-4 for more information on alternate pipe laying methods.

BES requires a "flexible joint" near all structures. The first pipe joint must be within 18" of the exterior wall of a manhole. Inlet pipes are to be 8'-0" below finished grade when entering manholes or within 14" above the manhole flow line, whichever is less, unless shown otherwise on the plans. In all cases inlet leads shall be connected below the cone section, a minimum of 8" clear of a precast section joint and 12" clear of joint in base section. Standard Drawing P-150

00445.43

All plastic pipes are installed with flexible pipe bedding. PVC or HDPE pipe should be laid on a minimum 4 inches of 3/4"-0" crushed rock bedding below the pipe and 1 foot of the approved granular material above the pipe. Approved sanded collars must be used to connect plastic pipe to manholes and inlets. Fused joints or special PVC gasket couplings are normally approved to join sections of pipe.

Backfill and Compaction

00430.46

Before backfilling operations, the Inspector should measure cave-ins and note any other damage caused by the Contractor. While backfilling the "pipe zone" special care needs to be taken by the Contractor, to avoid damaging the pipe. Trench backfill material must be an approved granular material.

Trench backfill compaction may be done with a backhoe-mounted hydraulic compactor, or by smaller equipment such as a "jumping jack". Backfilling and compaction is typically accomplished in several lifts. It depends on the equipment being used, the type of pipe, and the depth of the trench. The Contractor is required to compact all pipe trenches to 95% of the maximum density in the right-of-way, and to 90% of the maximum outside the right-of-way. The Inspector should contact the Field Supervisor or QA/QC specialist for testing requirements.

Trench shoring should remain in place during the backfilling. The jacks or braces may be removed from the bottom up, as the top of the backfill begins to cover them.

The Contractor should keep the edges of the trench clear during pipe installation work and must remove any excess material and clean off the street when backfilling and compaction is completed.

Sump Construction

Although this method is less common, storm sumps are occasionally allowed. The design of a sedimentation manhole and sump drainage system is based on soil calculations and water runoff capacity. The number of sumps needed is determined by BES based on experience gained from other drainage systems within the area. The sumps are tested as soon as possible after construction to confirm the runoff capacity.

The Inspector should make sure that drain rock used around sumps conforms to specified gradation requirements and geotextile fabric must be installed between the drain rock and the crushed granular backfill material per BES Standard Plan P-165.

Sump testing information will be included in the project special specifications. The Contractor is responsible for renting the sump testing equipment from BES and does all the sump testing. The BES inspector must be present during the actual performance of each test. The BES inspector will observe the work and fill out the required reports. The acceptance of the results rests with BES. Sump test reports must be filled out for each test performed. The originals are turned into BES, with a copy for the PBOT Office file.

Swale/ Water Quality Planter

Water quality facilities are constructed within the ROW and can be either a swale or a planter configuration. These types of facilities can be for improving water quality and often incorporates disposal by infiltration into the ground.

Swales and planters will vary in width between the curb and sidewalk. This is frequently accomplished with curb extensions along existing streets. Caution needs to be exercised when inspecting the curb/sidewalk to get the elevation correct. The front of the sidewalk is not at 2% from top of curb, it will most frequently be equal to the top of curb. The water quality facilities should be adjusted to match hard surfacing concrete/asphalt; do not adjust hard surfacing to match water quality facility features.

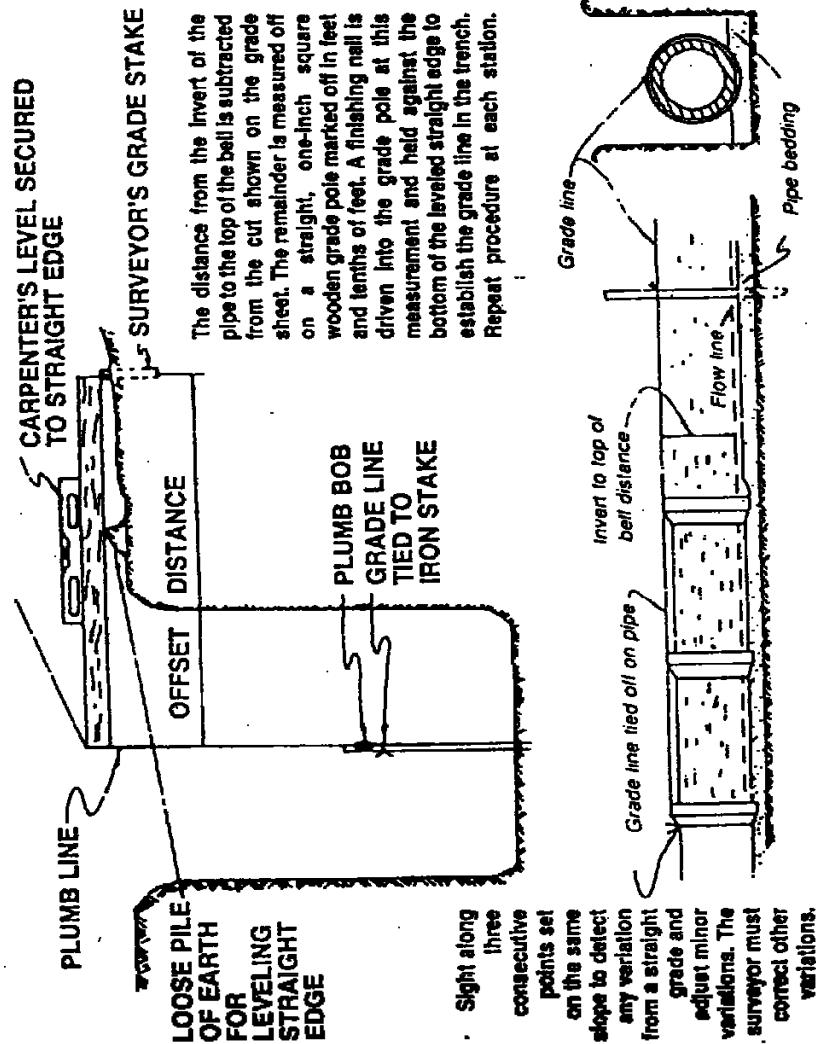
The Inspector is responsible for the curb and sidewalk inspections and verification that water quality facility features are at correct location, elevation, and meet ADA criteria. The BES inspector will inspect planter walls, inlets, rock trench, topsoil, and plantings that are within the facility.

END OF SECTION 10

DRAINAGE: INSPECTOR'S CHECKLIST

- Check the dimensions of inlet frames and grates. Are all grates the specified type and bicycle safe?
- Check for concrete pipe certification numbers, dates; verify with materials testing laboratory.
- Check the line and grade of the trench excavation. Verify the alignment and depth. Measure and record depth of pipe trenches at the time of excavation for as-builts and pay quantities.
- Check that inlets are located to intercept water. Check concrete finish work on all inlets. Is there a 45° bevel at the back to divert water into the inlet? Is the inside of the inlet finished? Are there weep holes? Are the weep holes blocked?
- Check the top of the inlet for proper slope to the centerline of the street (parabolic or straight grade). Depress back of inlet 1"-2" unless inlet is in a bike lane, or adjacent to an ADA ramp or driveway.
- Verify that the pipe bedding is according to the required class. Is it adequate to accommodate pipe bells?
- Check that curves, if required, are being laid in accordance with pipe specifications. Are pipes seated with proper gaskets?
- Check that adjusted manholes have been mortared.
- Verify that inlet wall thickness is per plans. Check slope of invert slab, distance from curb top. Is there proper connection to pipe, as per specifications?
- Check that approved granular material is being used for backfill. Is the compaction as required?
- Make sure that heavy equipment does not cross over pipe until there is sufficient backfill to distribute the load. If the pipe is shallow, use HDPE or ductile iron pipe or encased concrete pipe. Talk to Field Supervisor or Construction Manager for recommendations.
- Adjust manhole and utility boxes to fit finish grade. Is the first step within the manhole no more than 26" down from the frame?
- Verify type of water quality facility that is to be constructed. If planter, walls need to maintain 4" exposure adjacent to hard surfaces.

HAND METHOD FOR SETTING BOTTOM LINE FOR LAYING SMALL DIAMETER PIPE

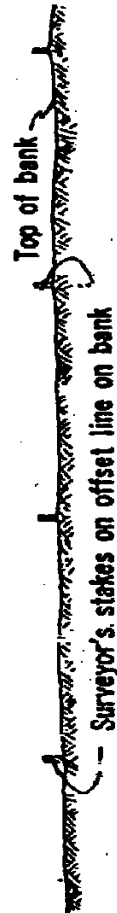


**Exhibit 10-1
LAYING SMALL DIAMETER PIPE**

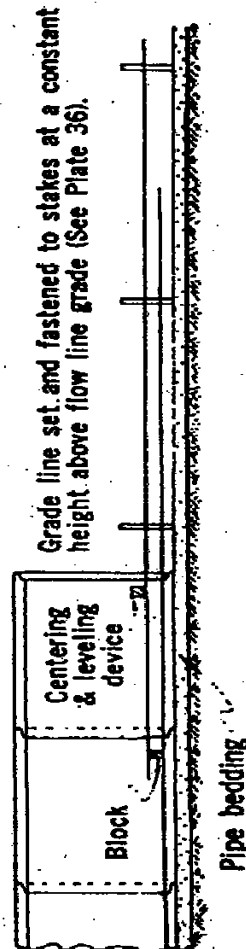
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NOTES

BOTTOM LINE METHOD FOR LAYING LARGE DIAMETER PIPE



NOTE: Use not less than three stakes in trench.



Chalk line stretched through to bell end of second joint and held on top of block which is a certain height corresponding to measurement between grade line and flow line grade.

2 x 4 with carpenter's level attached is set in the end of the last joint of pipe. A short plumb bob is suspended from the center of the 2 x 4 to indicate center line of pipe. Sight along grade line to check that it is straight and on line with the plumb line.

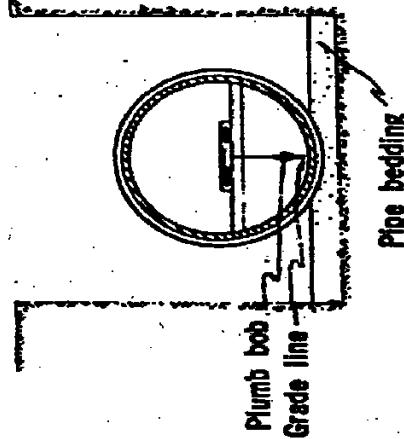
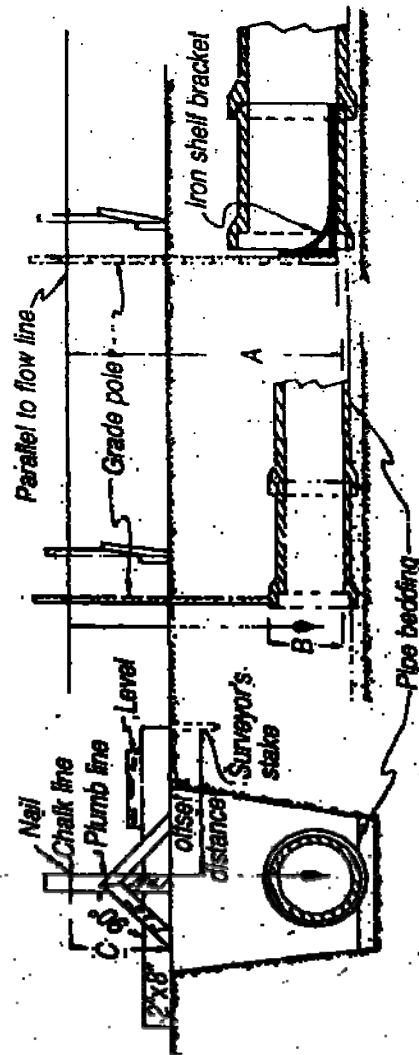


Exhibit 10-2
LAYING LARGE DIAMETER PIPE

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TOP LINE METHOD FOR LAYING PIPE

TO BE USED WHEN
STAKES OR LINES
CANNOT BE ESTABLISHED
IN TRENCH BOTTOM,
DUE TO WATER, BAD
GROUND OR WIDE
TRENCH



METHOD FOR PIPE 24" AND UNDER

FOR 27" AND OVER

A frame, with a horizontal 2 x 8-inch board of sufficient length to span the ditch and extend to offset line, is set perpendicular to the offset line and staked rigidly in place at three or more consecutive stations.

A convenient dimension (shown as A) is established to be used as a constant between top line and flow line grade.

Subtract cuts shown on grade sheet from dimension A and remainder will be distance C to be measured up from bottom of 2 x 8 for setting nail in edge of 1 x 6 upright for top line. This edge of upright must be exactly on center line of pipeline.

Sight along top line for a distance of three or more frames to check for straight grade. Adjust small variations to a straight grade. Surveyor must correct other variations.

Alignment of pipe is set and checked with a plumb bob suspended from the top line and sighting along top of pipe laid.

Grade for pipe sizes 24 inches or less is set and checked with a grade pole. Dimension B (distance from flow line to top of bell) is subtracted from dimension A, and the remainder is measured off on the grade pole. A finishing nail is driven into the grade pole at this measurement and held up against the top line to establish the grade of the top of the bells of the pipeline. Once set, the grade pole need not be changed unless dimension A or the pipe size is changed.

Grade for pipe sizes 27 inches or larger is established by fastening a shelf bracket to the bottom of the grade pole and measuring from the heel of the bracket the dimension A and driving a finishing nail in the grade pole. Use grade pole to set and check flow line grade from the top line as described above.

Exhibit 10-3
TOP LINE METHOD FOR LAYING PIPE

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ALTERNATE MECHANICAL METHOD FOR SETTING A BOTTOM LINE FOR LAYING PIPE

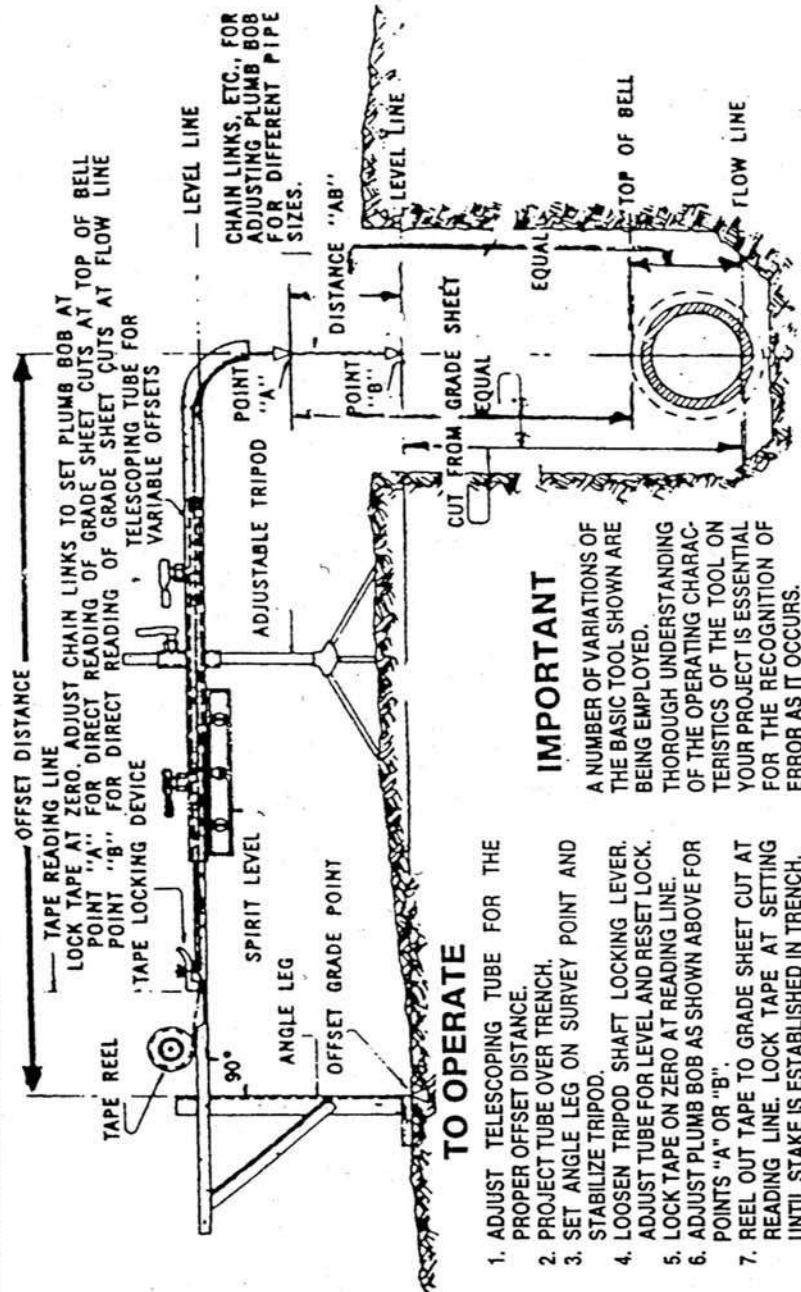


Exhibit 10-4
BOTTOM LINE METHOD FOR LAYING PIPE

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11 - BASE CONSTRUCTION

GENERAL

The structural section of a roadway may include placing a sub-base or aggregate base course and several HMAC/MWMAC courses or plain concrete paving. The designed thickness of the street section is determined by the strength of the sub-grade soils and the type of traffic use expected and estimated traffic volumes.

It is essential that the Inspector has checked the line, elevation, and cross-section of the sub-grade prior to placement of the aggregate base material. The Inspector makes the determination as to whether the grade is ready for placing the base course(s) and subsequent paving lifts.

See
Section 9

MATERIALS SAMPLING AND TESTING

Density tests are often required for sub-grade compaction as well as for the roadway aggregate base courses on large projects. Proof-rolling (deflection testing) is still the best method for locating areas of unacceptable material. More detailed information was discussed in Section 8: AGGREGATE BASE CONSTRUCTION.

See
Section 8

BASE MATERIAL

Untreated Roadway Base

Untreated roadway base is material that has been processed to conform to certain limitations in grading and physical properties.

00640

- *Aggregate Base Course* is often referred to as base rock and is produced from crushing, screening, and blending quality rock sources in desired gradations. Leveling courses may be 3/4" minus material, structural base courses should be 1-1/2" minus or 1" minus material. The Standard Construction Specifications 02630 & 02640 lists the gradation requirements.
- *Recycled Base Material* must meet the same gradation requirements as crushed aggregate base. The target proportions of asphalt grindings and crushed concrete is 50% blend of each, plus or minus 10%. Acceptance for this material is specified as a visual basis only.

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Care should be taken to check the aggregate base as it is unloaded to see that unsuitable soils, brush, grass, debris, or organic material is not mixed in. If the Inspector notices any of these conditions or a change in material, they should reject the use of the material in the roadway. If any trucks have dirt stuck in the box, stop further hauling until additional testing and sampling can be conducted and new material can be brought in.

00640

Treated Roadway Base

Treated roadway base is used primarily for arterial road construction in order to reduce the amount of aggregate base and or HMAC/MWMAC required.

- *Asphalt treated base (ATPB)* is a mixture of aggregate and either hot mix or cold mix asphalt. The former is heated plant mixed, and hot laid. Both are placed on prepared sub-grade prior to compaction.

BASE CONSTRUCTION

Inspection before Placing Base Material

Prior to placing base material, the top 1-foot of the sub-grade should be scarified and compacted, then proof-rolled to determine any soft spot locations. (Make sure any soft spot excavations are accurately measured and backfill quantities documented.) In addition:

- Check to make sure the equipment used is appropriate for the job.
 1. Anticipate problems by keeping ahead of the work being performed and observing the general direction of the construction in progress.
 2. Ensure that underground and utility work, including trench backfill, is completed (unless otherwise approved by the Construction Manager).
- After the base has been tested for specified densities, ensure that the Contractor protects it from damage until it is covered with pavement.

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Line and Grade

Line and grade should be maintained by using a string line and straightedge measurement checks on the base. All streets should be checked at 100-foot intervals at the centerline, both curbs, and quarter points. Try to measure between the Contractor's set of controls. The allowable surface tolerance is +/- ½ inch per Standard Construction Specifications. Report the string line check to the Contractor and record it in the daily progress report.

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Spreading of Base Material

Spreading of base material is outlined in the Standard Construction Specifications. If the material is spread in a non uniform manner, or if segregation of the product has occurred, the problem needs to be corrected before additional material is spread. Check for the following:

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00640.42

- Lift thickness should not exceed 6-inches.
- To minimize segregation, materials should be premixed and moistened prior to delivery to the site, or water should be added prior to processing material with the grader.
 - 1. The proper base material(s) must be used.
 - 2. Loads should be spread by tailgating and then leveled, with the motor grader making the minimum number of passes before rolling.
 - 3. The base material should be sufficiently moist to achieve compaction and avoid segregation.
 - 4. Compacting with a roller will lock the particles together so that subsequent spreading and grading can take place without segregation.

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Compaction

Compaction of the aggregate base increases the strength and load-bearing ability of the structural section and decreases the possibility of future settlement and maintenance. The smoothness of the completed base course is important and has a direct effect on the outcome and appearance of the final pavement surface, especially HMAC/MWMAC pavement laid by a mechanical paving machine.

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Compaction operations should result in the following two characteristics:

- The final density meets the specifications with no deflection.
- The required surface shape, smoothness, and uniformity are reached.

The Inspector needs to be familiar with both compaction equipment and methods, as there is a wide variety of each used to achieve the specified compaction requirement. The principle factors and variables in compaction are:

- Size of the area
- Type of base material(s)

- Amount of moisture present
- Thickness of the lifts
- Type of equipment
- Number of passes by the equipment on each lift

The Inspector or Construction Manager will make the decision as to whether the grade is ready for placement of HMAC/MWMAC. Be sure to check the line and grade of the base material prior to allowing the placement of pavement lifts.

WEATHER LIMITATIONS

The Inspector should be aware of the limitations and adequacy of work performed in inclement weather. If satisfactory results cannot be achieved due to weather conditions on a particular day, the Inspector should notify the Construction Manager, who may suspend all grading operations. Do not allow any base materials to be placed in snow or on soft, muddy, or frozen sub-grade.

00180.85

Special considerations apply if the contractor wants to build streets during the rainy season. Over-excavation with geotextile fabric and an additional course of larger aggregate, or a thicker base rock section is preferred. Due to the additional cost issues, the Construction Manager must approve any such changes prior to the construction alternative. The Contractor will also need to replace mud-contaminated base rock prior paving.

END OF SECTION 11

BASE CONSTRUCTION: INSPECTOR'S CHECKLIST

- Check sub-grade elevation and cross-section before allowing base materials to be placed. Is the sub-grade dense and properly compacted?
 1. Establish line and grade, offset crown, before placing base courses.
 2. Check to see that the Contractor is following appropriate public safety methods such as protective covers, fences, barricades, lighting, warning devices, signs, etc.
 3. Verify that all drains, utilities, or other underground construction items have been installed.
 4. Check that the locations of all manholes, outlets, and other surface features are known and marked.
 5. Determine if the type and quality of the base rock is correct and of uniform quality.
 6. Check that the base material is being placed correctly to avoid segregation.
 7. Verify that the base material has been placed in required lifts and compacted as specified.
 8. Observe that the Contractor is using appropriate equipment and methods, consistently throughout the project (uniform moisture control, mixing, lift thickness, compaction, etc.).
 9. Verify that the appropriate testing is being performed and recorded, as required.
 10. Watch for changes in grading and quality of base material. If warranted, order additional sampling and testing.
 11. Check for movement under rollers and hauling equipment to detect soft spots.
 12. Verify that the Contractor is performing proper dust control methods.
 13. Restrict to check the Contractor's staking. Check grade at manholes, valve boxes, curbs, etc.

14. Check for grade, cross-section, and surface smoothness of final base grade. Use a string line at 100-foot intervals and record findings in daily progress report and to the Contractor.
15. Check the method used for protecting the base until pavement is laid.

NOTES

SECTION 12 - CONCRETE

GENERAL

Concrete is a much used construction material, especially in street construction for curbs, sidewalks, paving, etc. It is a natural product made up of coarse and fine aggregates, water, and cement. The cement part of concrete is what bonds all the ingredients together through a chemical process called hydration. Quality concrete work is dependent on proper measurement, proportioning, and mixing of the ingredients, and then proper handling, transport, placement, finishing, and curing of the concrete mixture.

This section includes general information about concrete as a material, inspection procedures during concrete construction, and an Inspector's checklist. The first part deals with the components of concrete, concrete strength, materials used in concrete construction, and working with concrete. This is followed by procedures and practices for constructing concrete curbs, paving, sidewalks, driveways, and walls.

MATERIALS SAMPLING AND TESTING

Sampling and testing responsibilities were previously provided in Section 8. Generally, a certified QCT is responsible for checking that concrete load tickets have the correct, approved mix design numbers and for performing the slump, air, and cylinder tests. The Inspector should monitor the sampling and testing work as well as the Contractor's placement methods, materials, and workmanship.

**See
Section 8**

COMPONENTS OF CONCRETE

Portland Cement

Portland Cement is a finely ground mineral product composed of silicates, aluminates of calcium, and gypsum. When combined with water, these elements will undergo a chemical process called hydration and harden into a mass that has high compressive strength.

There are five Portland Cement types. In addition to the five types, special properties or special purpose cements may also be specified. These include low alkali content, plastic cement to obtain greater workability, and waterproof cement to inhibit water flow through concrete. Normally, only Type I and II are used in the City; however, Type III cement may also be used.

- **Type I** *Normal Portland Cement*
Used for general construction purposes where special properties are not required.

- **Type II Moderate Sulfate Action**
Moderate Heat of Hydration
 Used for sewer pipelines and structures because of its higher resistance to corrosion.
- **Type III High Early Strength**
 Used for mixes requiring an early high compressive strength.

Admixtures

Admixtures are materials added to the basic concrete mix of aggregates, sand, water, and cement. Admixtures are included to improve workability and durability, accelerate or increase hardening, disperse cement particles, retard setting time, reduce shrinkage, reduce heat generation during hardening, create a lightweight concrete, and provide for waterproofing or coloring.

Admixtures cannot correct the problems of a poor concrete job and are not applicable for all projects. The Construction Manager must approve the use of any admixtures in a concrete mix design during his review of the concrete submittals for each project.

- *Accelerators* are used to speed up concrete setting time and increase the rate of hardening in a mix. In general, an accelerator is specified in order to remove forms early, shorten curing time, offset weather conditions, or compensate for the retarding effects of another admixture. In addition to patented accelerators, calcium chloride may be used when there is no steel or other metal in the concrete.
- *Retarders* are admixtures used to delay the effects of hot weather setting up the concrete too fast. They are usually mixed with additional gypsum.
- *Plasticizers* are used to increase the workability of concrete, and include hydrated lime, fly ash, diatomaceous earth, and bentonite. These admixtures usually require a higher water-cement ratio in the mix.
- *Air-entraining agents* cause air to be introduced into the mix to increase workability, decrease density, decrease strength, reduce segregation of the constituents, and increase durability under freeze/thaw conditions. Generally, sand is reduced in the mix to approximately equal the amount of air being entrained, and cement is increased to offset any potential loss of compressive strength. The mix may bulk up as a result of air-entrainment, producing a higher yield.

These admixtures must be carefully monitored through field tests. If too much air is introduced, it will reduce the concrete strength. The loss of compressive strength on concrete from air entrainment is 5% for each 1% of air entrained. More than 6% may result in a substantial loss of compressive strength.

- *Dispersing agents* are wetting agents that permit a reduction in the water-cement ratio, allowing for increased workability. Setting time may be slower with dispersing agents.
- *Pozzolan materials* are minerals that may be added to replace or reduce the amount of cement used in a concrete mix. A pozzolan will chemically react with lime to form compounds with cementitious properties. The selection of pozzolan materials must be monitored and used cautiously. These admixtures may increase the normal water-cement ratio or they may introduce adverse characteristics into a concrete mix, resulting in shrinkage and reduced strength and durability.
- *Fly ash* is a low-cost material used to reduce the amount of cement required in a mix, especially on projects involving large quantities. Only Class C and Class F fly ash can be used in concrete mixtures and only with approval of the Construction Manager. The maximum amount of cement replaced shall not exceed 30% by weight.

CONCRETE STRENGTH

Concrete continues to gain strength over many years, with the majority of strength gained in the first few days after placement. Its compressive strength (PSI) at 28 days is the standard method for the acceptance of concrete strength and quality.

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Concrete's strength and durability is based on the amount of water and cement added to the mix. The lowest amount of water and the highest amount of solids (aggregate and cement) will produce the strongest product. However, water is necessary to ensure that the concrete is workable and can be finished properly. The gradation of the aggregate ingredient is also important in producing acceptable concrete strength. See Exhibit 12-1 for additional information on cement strength and the effects of water content on the compressive strength of concrete.

The proportion of water used with the amount of cement is called the "water-cement ratio." Very little water is needed to initiate the chemical reaction in the cement and cause it to harden. Additional water is used to keep the concrete in a plastic state for transporting and placing.

It is important that the water-cement ratio is not exceeded. Too much water can increase bleeding (excess water on the surface), shrinkage, extend the time required for proper finishing, and reduce the durability of the concrete. The moisture content of the concrete should be kept as uniform as is possible given the variables of the moisture content of the aggregate, the weather, and placement schedules.

A small amount of water can be added to a mix that is too stiff to place and properly finish. If water is added at the job site, it should only be done before placement of the load. The load must be remixed to incorporate the water into the entire batch. The standard practice

to achieve uniform mixing is to revolve the mixer barrel a minimum of 40 times.

MATERIALS USED IN CONCRETE CONSTRUCTION

Curing Compounds

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Curing compounds are liquids that form a membrane over the surface of the concrete to seal it. During the placement of concrete, much of the water in the mixture can be lost by evaporation from the surface. Colorless and pigmented compounds are available. These sealants should never be used where subsequent concrete or mortar needs to bond with the concrete.

- *Clear curing compounds* are paraffin based and leave a residue. This is the most commonly used type on City street jobs. To assist in applying the sealant uniformly, a dye is injected into the compound that loses its color when exposed to sunlight or when washed.
- *Black pigmented compounds* include bituminous emulsions and coal tar cutbacks. They are generally used on concrete bases for HMAC pavements and for waterproof membranes on concrete walls.
- *White and light gray compounds* are ground pigments mixed with a liquid solution; when applied, they present a uniform color, concealing the natural color of the concrete. The light color reflects direct sunlight and significantly reduces cracking from expansion and contraction. These compounds must be used on State (Federal Aid) projects.

Joint Material

Joint material is used in expansion joints. Pre-molded expansion joint filler remains plastic throughout its life and is not damaged or deformed during normal handling or when exposed to weather conditions. Commonly used types include:

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- Preformed bituminous (meeting ASTM 1752)
- Non-extruding/resilient filler (bituminous type)
- Non-extruding/resilient filler (non-bituminous type) consisting of sponge rubber, cork, and self-expanding cork. (Backer rod)

Mortar

Mortar is composed of Portland cement, sand, and water, resulting in a plastic mixture. Aluminum powder is added to offset the shrinkage in mortar due to excess water. This additive should be approved by the Manager and should only be used by skilled concrete

workers who have had some experience in working with it.

Grout

Grout is a cement mortar that is watered down so that it will be fluid and flow readily. Neat cement grout is Portland cement mixed with water to a fluid consistency.

Membrane Waterproofing Materials

Membrane waterproofing materials include asphalt coatings, polyethylene sheets, asphalt/plastic panels, roofing felt, butyl rubber sheeting, and other asphalt based sheeting in rolls. These materials are used primarily on projects with vaulted sidewalks and will be specified on the plans.

Concrete Reinforcing

Concrete reinforcing is done for added structural strength with steel bars or welded wire fabric. No coatings of any type should be allowed on reinforcement material, as it would interfere with the bond between the steel and concrete.

- *Steel bars* - Typically ASTM A615 Grade 60 are used because of their high tensile strength and are easily fabricated. The deformations on the bars increase the bond between the steel and the concrete. Hooks or bends in the bars increase anchoring abilities.

The Inspector is responsible for verifying that the proper size and type of reinforcing bars are used. (See Exhibit 12-2) The Inspector 00530 should check to make sure steel bars are being placed correctly and in conformance with the desired principal reinforcing pattern. The Inspector should check the dimensions, lengths, depths, and radii and to make sure the bars are continuous or spliced properly. Bars must be adequately embedded in the concrete with clear cover and tied at all intersections with annealed wire.

Reinforcing bars are supported by a variety of types of supports, from concrete blocks to metal or dowel blocks. Manufactured 00530.41 concrete blocks are the most widely used type of support.

- *Welded steel wire fabric* for use in concrete slabs is designated by the size of the openings of the longitudinal and transverse wires and the gauge of the wire. (See Exhibit 12-3.) For example:

6 x 6-10/10

Delineates mesh openings that are 6 inches square and wire that is all 10 gauge. This fabric is known as "two way."

If the primary reinforcement is in one direction ("one-way"), the designation would read:

4 x 12-6/10

The mesh openings are rectangular and the longitudinal wires are spaced at 4 inches and are 6 gauge and the transverse wires are spaced at 12 inches and are 10 gauge.

Concrete Formwork

Concrete formwork must hold a shape during placing and working concrete. The formwork must be properly braced and tied with adequate form ties to resist the forces working against them. They must be tight and free from holes, loose seams, or other blemishes that would result in mortar leaking or undesirable patterning on the surface of the concrete.

Forms are generally made of wood or metal. The former can be reused several times if taken care of, and the latter can be used indefinitely if not damaged. Warped or bent forms should be rejected. All forms should be clean and lightly oiled to prevent fresh concrete from sticking to them. Oils or other coatings should be applied prior to placing any reinforcement; otherwise, they may coat the steel and prevent a bond with the concrete.

The use of 2" x 4" or 2" x 6" lumber with wooden stakes is suitable for sidewalk and driveway construction, but should be discouraged for use as 16" curb forms. Curb forms are usually made of heavy-duty plywood panels with a 2" x 4" bracing framework for added strength, and made specifically for pouring standard 16" curbs. On corners, thinner plywood may be used for rounded curb sections, but additional staking is required. Long metal stakes or screw-type metal bracing work better than wooden stakes, especially in monolithic curb and sidewalk pours.

- *Spreaders and Saddles* are used to keep the forms the proper width during concrete placement. Spreaders should be removed as the concrete is placed within the forms and the saddles are removed after initial "set" so the face of curbs can be properly finished.
- *Form ties* are used to keep the forms from spreading during concrete placement for retaining walls. The types and sizes range from rods and straps to heavy clamps and bolts. Stud-rods (also called she bolts) are commonly used and are a threaded steel rod and clamp assembly. The Inspector should verify the type being used is consistent with any required approvals. Form ties should not result in any embedment near the surface.

WORKING WITH CONCRETE

Weather Conditions

Weather conditions, including the ambient temperature, have a significant effect on the development of strength and durability of concrete. High temperatures will accelerate hydration and curing, while cold temperatures slow it down.

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Hot weather will cause the concrete to set up faster and increase shrinkage and subsequent cracking on the surface. Special precautions should be taken to prevent hot weather damage when placing concrete if the ambient air temperature exceeds 85 degrees F. The Inspector should see that the Contractor makes every effort to have the concrete placed immediately after mixing and always within 90 minutes of loading at the batch plant. The Contractor should not continually add water during placement. The use of any accelerator admixtures should be avoided. Other steps to assist in proper placement include:

- Use a retarding agent in the mix.
- Use crushed ice or chilled water in the mix.
- Dampen the sub-grade and forms and protect from wind.

Cold weather, especially freezing and thawing conditions can do the most damage to freshly poured concrete. The water in the mix expands as it freezes and will contract as it thaws, significantly reducing the strength and coherency of the concrete. In general, it is best not to pour concrete under freezing conditions or when the ambient air temperature is below 35 degrees F. However, if necessary, the following steps may be taken to help prevent the freezing of concrete:

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- Do not pour on frozen ground. Wait until the ground thaws.
- Protect the concrete work with special insulated blankets or other methods if temperatures are predicted to be 35 degrees or less in the next 5 days.
- Use high early strength cement.
- Preheat the mixing water and/or aggregate.
- Cover the concrete and heat with steam or salamanders (space heaters).
- Use air-entraining agents in the mix.
- Use accelerators such as calcium chloride (for non-reinforced concrete only).

Transporting, Handling, and Placing

Transporting, handling, and placing methods and equipment should always avoid segregation of the components of concrete. Segregation of components must be prevented because it cannot be corrected afterwards. All equipment should be in good repair, operate properly, and have the appropriate capacity for the size of the placement.

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Some general rules of thumb are:

- The sub-grade elevation should allow for the full thickness of the concrete. The sub-grade should be dampened prior to placing.
- Concrete must be used within 90 minutes of initial mixing. The batch time on the ticket should be checked to verify compliance. 00440.40
- Concrete should be handled as little as possible and discharged directly into forms.
- Forms should be clean, adequately braced, constructed tightly, and wetted before placement. 00540.45
- Phased concrete placement should take into account traffic flow of equipment and continuity of supply.
- Concrete should never be allowed to free-fall more than 5 feet. Metal or rubber tremies should be used. 00540.48
- Discharging in large quantities at one point should be avoided. The mortar tends to flow ahead of the aggregate, resulting in segregation.
- Tempering the concrete load more than once should be avoided. The necessary water should be added at the start of each load and mixed thoroughly to reach the desired slump, and then no more water should be allowed.
- Water used for cleaning the truck and chutes should not be allowed to drain into forms.
- High slump concrete and very low slump concrete should not be pumped. It would result in segregation and clogging of the mixes, respectively.

Joints

Joints are installed to control expansion and contraction movements due to weathering and curing. Predetermined joints are designed and installed in all concrete work of any size.

- *Expansion joints* are made from compressible materials and permit the concrete to expand. Preformed expansion joint material is used. Expansion joints should extend to the full depth and width of the concrete and should be installed, around utility pole bases and other structures that are 30 or more inches in width. These joints are occasionally constructed with dowels or keyways to transfer loads without affecting the slab alignment. 00756.48
00759.48
- *Contraction joints* are purposefully constructed into the surface of the concrete to control or direct cracking. The contraction joint provides a weakened plane that induces cracking to occur beneath the joint where it is less visible. They can be constructed by using a tapered "T"-shaped bar, by deep scoring with a grooved tool into fresh concrete, by saw cutting, or using oiled knives inserted into plastic concrete. In curbs, joints should extend one-half the depth; in sidewalks and driveways, joints must extend one-third the depth. When finished, a tooled joint should extend the full width of the concrete surface. 00759.49
- *Contraction joints* should be spaced no more than 15 feet apart. Sections of sidewalks are typically scored with a 3 x 3 feet square pattern.

Concrete Placement and Finishing

Concrete placement and finishing is highly important and is the measure for judging the quality of the final concrete work. It is possible to have a structurally sound slab that serves its purpose and yet is unacceptable because of a poor finish job.

Finishing is a costly operation to the Contractor in terms of labor. Some Contractors attempt to cut costs by not hiring an adequate number of finishers to complete the job satisfactorily. The Inspector should be aware of the size of the project, the number of finishers, and their ability to perform the work.

If finishing is proposed to take place after the Inspector has completed his workday, the Contractor must be aware that the work must meet the established standards for the project. Substandard work can be rejected.

To facilitate good finish work, low-slump concrete (not exceeding 6 inches) should be used. This will minimize bleeding, which can cause scaling and dusting on the surface. Water-reducing and air-entraining admixtures will also minimize bleeding. Final trowel finishing should not be started too soon, or it will weaken the surface and will cause it to deteriorate rapidly in the weather.

The basic steps for finishing are:

- ***Spreading and vibrating:*** Concrete should be placed uniformly to the full depth of the forms and as near as possible to the final position. Placement should start in a corner, avoiding excessive drag or flow of the concrete. Concrete should be spaded or vibrated to consolidate it and eliminate voids and honeycombs. After concrete has been spread and spaded to fill the forms, screeding follows immediately.

It is of utmost importance that these operations are performed before bleed water collects on the surface. Any operation performed on the surface of a concrete slab while bleed water is present will cause serious dusting and scaling.

- ***Screeding:*** Screeding (Roding) is striking off the excess concrete between the form headers. As the screed is pulled forward, it should be tilted in the direction of travel to obtain a cutting edge. Power screeding is accomplished with equipment called vibrating screeds, oscillating screeds, and rolling screeds.

Concrete should not be spread over too large an area before being struck off, nor should a large area be struck off and allowed to remain before bull-floating or darbying.

- ***Bull-floating and darbying:*** Bull-floating or darbying immediately follows screeding. The purpose of these operations is to level ridges and fill voids left by screeding and to embed all particles of coarse aggregate slightly below the surface. Bull floats are large, long-handled floats made of wood or metal. The bull float should be pushed ahead with the front (toe) of the float raised so that it will not dig into the concrete surface. The tool should be pulled back with the float blade flat on the surface to cut off bumps and fill holes.

The preceding operations should level, shape, and smooth the surface and work up a slight amount of cement paste. The concrete should not be overworked, since this can result in a less durable surface. Immediately after the bull-float or darby is used, the concrete should be cut away from the forms to a depth of 1 inch, using the correct edging tool or a margin trowel.

- ***Final Finishing:*** The finish operations of edging, jointing, floating, troweling and brooming must wait until all bleed water has left the surface and the concrete stiffens slightly. This waiting period is essential to obtain a durable surface, and will vary with weather conditions including wind, temperature, and relative humidity and with the type and temperature of the concrete. Finishing should begin when the water sheen is gone and the concrete can sustain foot pressure with approximately 1/4-inch indentation.

1. *Edging* produces a neat, rounded edge that prevents chipping or damage, especially when forms are removed. Edging also compacts and hardens the concrete next to the forms where floats and trowels are less effective. Preliminary edging should be delayed until the concrete has set sufficiently to hold the shape of the edging tool. The front of the edger should be tilted up slightly when moving in a forward direction. When moving backwards over the surface, the rear of the tool should be tilted slightly.
2. *Jointing* is done after, or while, edging is being performed. Proper jointing practices can eliminate unsightly random cracks. Contraction joints are typically made using hand tools while the concrete is still plastic, or sawn after the surface has sufficiently hardened. Sawed joints are most common with concrete roadways, sidewalks and driveways should be jointed while concrete is plastic.
3. *Floating* the surface occurs after edging and jointing. Floating has three purposes: 1) to embed large aggregates just below the surface; 2) to remove any imperfections left in the surface by previous operations; and 3) to compact the concrete and consolidate the mortar at the surface in preparation for additional finishing operations. The hand float should be held flat on the concrete surface and moved with a slight sawing motion in a sweeping arc to fill in holes, cut off lumps, and smooth ridges.
4. *Troweling* the surface is performed after floating. Steel troweling produces a hard, dense surface. Troweling should never be done on a surface that has not been floated. For the first troweling, the blade should be held flat on the surface. The first troweling may be sufficient to produce a surface free of defects, but additional troweling may be used to increase smoothness and hardness. If necessary, tooled edges and joints should be redone after troweling to maintain uniformity and true lines.
5. *Brooming* is done to provide better traction for foot traffic, and is done by roughing the surface slightly with a broom or bristle brush. Broom direction for the following is illustrated in Exhibit 12-4:

Curbs	Longitudinal (face and top)
Sidewalks	Right angles to pedestrian flow
	Parallel to curb at corners
Driveways	Combination of each

Curing and Protection

Curing and protection processes are used to slow down moisture loss from concrete. It is necessary for sufficient moisture to be retained in the mix after placement and finishing for the chemical reaction to take place. Premature drying stops the hydration reaction and weakens the concrete. The strength of the concrete will only increase with age as long as moisture is present.

The two methods for curing concrete are: 1) retention of the water within the mix by sealing with liquid membrane compounds, and 2) adding water to the hardened surface of the concrete by covering with wetted burlap, mats, sand blankets, etc. and then using sprinklers, soaker hoses, or ponding to keep it moist for several days.

Proper curing of concrete will result in the following characteristics desirable in concrete:

- Strength
- Wearing and abrasion resistance
- Reduced efflorescence
- Reduced shrinkage and cracking
- Impermeability (as a result of full hydration)

The curing method should remain constant to avoid cracking and crazing. Under normal weather conditions, curing should be not less than 7 days, or as specified by the Construction Manager. The Inspector should check to see that the Contractor follows and maintains these protective measures while the concrete is curing:

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- Be especially vigilant of curing and protection during hot weather.
- Liquid curing compounds should be sprayed in two directions for full coverage.
- The adequate amount of curing compound is being applied.
- Coverings are secured and edges are protected against the wind.
- A continuous, sufficient supply of water is provided.
- The new concrete is protected from damage by other construction activities.

CONCRETE CONSTRUCTION

Test Section Installation

The City may require the Contractor to construct a concrete walk test section to establish the standards of workmanship by which all subsequent work is judged for acceptance. A test section is always required for construction of concrete pavement as indicated below.

Preservation of Horse Rings, Historic Dates and Names in Concrete

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The City has a policy for replacing horse rings, historic dates and names stamped into existing street corners and curbs. These locations are usually identified during the design phase and are noted on the plans. The Inspector should notify the Contractor and the Construction Manager if a horse ring or historic stamp is not designated on the plans.

For new construction, the historic information (dates and/or street names, but not Contractors' names) should be re-stamped, and the current year should be added (e.g., 1933/2015). The Contractor re-installs the names and dates using a set of stamping tools provided by the Office. The stamping tools are available to the Contractor on a first come/first served basis. The Inspector should coordinate with the Contractor and make sure the stamping tools are returned to the Office as soon as possible.

Plain Concrete Pavement

A pre-paving meeting and test strip section is required before plain concrete pavement construction can begin. The Construction Manager should discuss the equipment and methods proposed by the Contractor and approve them. Although the finished pavement is the responsibility of the Contractor, satisfactory quality can often be traced to the competence of the Inspector, who is responsible for knowing where problems are likely to develop, recognizing any deficiencies needing correction, and reviewing the preparations with the Contractor.

The Inspector should examine the sub-grade and verify that any soft spots have been repaired. They should check the forms, check joint layout and spacing, and verify formed joints are properly aligned and secured prior to concrete placement. Manhole frames and covers, utility vaults, valve boxes, and other structures must be set to finish grade and construction debris and other loose material must be removed prior to any concrete placement.

The Inspector should check the forms to make sure that they are mortar-tight and set so the finished concrete will conform to the proper dimensions and contours. The forms should be sufficiently rigid to avoid distortion under pressure from the concrete and other loads incidental to construction operations. The Inspector should check to make sure that the forms are treated with an approved oil or wax or are saturated with water prior to placing concrete.

All spreading and finishing operations should be carefully observed to determine the need for adjustments. Checking should include stringing to identify high or low areas in the pavement, which should be corrected. Spreading machines should carry a nominal amount of concrete ahead of the strike-off blade at all times. Too much will make the machine "ride up," and too little will leave low spots that are hard to detect and difficult to correct. The tops of all headers should be kept free of concrete ahead of the finishing machine.

Joints should be constructed in conformance with the plans and specifications. Care should be taken to avoid depressions or humps at the joint, as these will be noticeable in the riding quality of the pavement. Exerting too much pressure on edging tools and floating too much mortar to the joint will be noticeable to motorists. The Inspector should verify that the Contractor lays a straightedge across all joints, including longitudinal joints, while the concrete is still green enough to permit a correction.

Weakened plane joints should be saw cut in accordance with the specifications. The depth of the saw cut is also critical to the development of controlled cracking at the saw cut and should be checked frequently during sawing operations. Saw cutting too soon will result in objectionable raveling of the concrete. If saw cutting is delayed too long, cracks will develop which could have been avoided. The correct time for saw cutting is indicated by slight raveling of the concrete (which is acceptable).

In addition, the Inspector should check for the following:

- The delivery ticket for the first load of concrete to verify the correct mix number, the time of loading, and that required physical tests are within specifications.
- The form alignment and rigidity should be continuously rechecked ahead of the placement operations.
- Workers should not walk on the new surface leaving footprints that fill with mortar, or track dirt onto the concrete surface during spreading.
- Finishing should be performed from outside the forms or from bridges spanning the slab.
- The Inspector should pay particular attention to the edges to see that sufficient mortar, compaction, and vibration are applied to make the concrete dense, homogeneous, and free of voids or honeycombs.

The practice of waiting until the sheen of moisture is gone from the surface before texturing is **not** advisable. In general, the best textures are obtained while the pavement is fairly moist.

Curbs and Gutters

The street curb, or curb/gutter combination, is usually the first improvement constructed and provides the line and grade reference for all subsequent work on the project, including the sidewalks and roadway paving. Driveway aprons and handicap access ramps are subsequently constructed monolithically, using the curb for grade. **"Drop curb" construction is NOT allowed per C.O.P. policy.** The following outlines general practices for curb construction, with specific inspection duties noted.

- *Mountable Curbs* should be treated the same as driveways and poured monolithically unless a 2" x 6" shelf in lieu of a keyway is specified. Any sidewalk behind a mountable curb should be thickened to 6" due to heavy trucks delivering materials to home sites.
- *Standard Curb* is set by transferring the line and grade from the hubs & stakes set by the surveyors. The line of hubs & stakes is usually offset 3 to 4 feet behind the curb. Its position and elevation is correlated with the plans with the appropriate cut or fill grade marked on the information stake. The back top of the curb form is set to this line and grade with a carpenter's level. The face of the curb is critical for water flow along the gutter. The batter of the curb face forms and the spacing of expansion and contraction joints should be checked by the Inspector for conformance.
- *Temporary Curb Crossing* To protect curbs during on-site building phase, it is recommended that boards be stacked 2" x 6", 2" x 8", and 2" x 10"s at least 16 feet long in front of the curb. Also, a gravel construction entrance at location of future driveways should be placed behind the curb. This will help protect the back of the curb and prevent excessive tracking of mud out onto the street.
- *Curb forms* should be checked after they are set. The Inspector should check for accuracy as to line and grade, curb height, proper batter and cross-section, rigidity, and form condition. Proper batter should be checked with a level. Any departure from the desired alignment should be detected by sighting down the front curb form. The Inspector should check forms at all critical locations, as follows:
 1. Point of tangency (PT)
 2. Point of curvature (PC)
 3. Point of reversing curvature (PRC)
 4. All breaks in grade (GB)
 5. Vertical curves (BVC or EVC)
- *Joints* in curbs and gutters are not usually shown on the plan. Typical joint locations are illustrated in Exhibit 12-5. 00759.49
- *Contraction joints* should be spaced no more than 15 feet apart. If the sidewalk width is 6 feet or less, contraction joint spacing should be equal to twice the width of the sidewalk. Make sure curb joints line up with future sidewalk, tree well spacing, and corner PCs and PTs.

- *Concrete* should be placed in the gutter portion of integral curb and gutter sections, first for a short distance and then in the curb portion shortly thereafter. A baffle board is used to deflect concrete as it is deposited from the mix truck. A baffle board avoids the impact and thrust of the stream of concrete, which can move forms out of line, and reduces the possibility of segregation. The gutter section should be spaded, followed by the curb section. Excess spading of the curb will result in slumping under the front face form and swelling of the gutter. Too little spading may cause rock pockets on the curb and gutter face. The Inspector should observe these operations to avoid these problems.
- *Keyways* may be specified when sidewalk is to be poured tight against the curb at a later date. **Drop curbs with keyways or dowels are not allowed per C.O.P. policy at driveways or ADA ramps.** The back edge above the keyway has a tendency to break off when driven over. Any drop curb exceptions must be pre-approved by the Construction Manager.
- *Blockouts* for corners, driveways, inlets or poles may be allowed, as long as this work is completed prior to top-lift paving.
- *Forms* should be realigned if necessary while the concrete is still plastic. The Inspector should check to make sure that all forms have remained in proper vertical and horizontal alignment and that the top width of the curb is uniform after the concrete is placed. The curbs can then be struck off and planed.
- *Curb face forms* should be removed when the concrete has set sufficiently to avoid slumping. The Inspector should check the curb alignment again and correct any misalignments by adjusting the back form while it is still in place. The Inspector should not allow bulges to be trimmed or indentations to be filled to correct poor alignment. 00759.50
- *Finishing* of the curb should first be done with a wood float, then troweled and given a broom finish. All joints of the curb and gutter must be vertical and at right angles to the face of the curb. **Sack finishing curb faces is not allowed.**

Slip form curbs and gutters manufactured by special machines are popular, because they do not require the use of forms. Instead a heavy string is set to guide the machine as it travels. The Inspector should check this guide string to the hubs for proper line and grade, as well as visually check it for a smooth flow around curves. The concrete is placed into a hopper and forced through a mold with the correct shape and is then extruded as the machine moves along. The correct concrete mix must be much stiffer than normal mixes (1 to 2 inch slump) and is specific for this use only. Expansion joints are not installed when curbs are extruded. Contraction joints are installed with a special saw, knife, or trowel. The Inspector should make sure the joints are properly constructed (i.e., the coarse aggregate is pushed away at least one-third the thickness to create a weakened plane).

The Inspector should make frequent checks of the dimensions of the curb face and top, the slope of the batter and top of curb slope, and the gutter width (when applicable). Machines have a tendency to drift off line and grade, especially in curves and tight radii. The best method is to do a final check behind the machine. Problems usually arise from improper operation of the machine and/or inconsistency of the concrete mix. Possible problems with broken vibrators or incorrect concrete slump may be indicated by the curb requiring a lot of finish work.

Sidewalks, Driveways, and Handicap Ramps

The conditions required for the layout of driveways and approaches are described in Exhibit 12-6. Driveways are typically constructed **monolithically**. References to the appropriate standard plan for sidewalks and driveways should be included in the construction documents. The Inspector should note these plans and any of the various wing configurations specified. Monolithic construction of curb and sidewalk is desired, although there are times where they may be constructed separately, as directed by the Construction Manager. Handicap ramps are always constructed monolithically, with the throat flush with the pavement. Again, *“drop curb” construction is NOT allowed per C.O.P. policy.*

Minimum thickness is 4 inches for a sidewalk, 4 inches for residential driveway connections, and 6 inches for driveways. Driveway approaches should have a 1-inch lip above finished gutter grade. Abandoned driveways should be removed and replaced with full-height curb and sidewalks.

When matching existing sidewalks, joints should be located in a similar pattern and spacing, not to exceed 15-foot intervals, in line with the existing sidewalk. All match points should be neat and clean (saw cut or equal) and at an existing joint.

- *Cross slopes* on a sidewalk should be constructed at a maximum rate of 1/4 inch per foot, sloping up from the top of the curb to the back of the sidewalk, unless otherwise specified. Ramping or warping sidewalks should be avoided, but can be done if it is minimal and properly transitioned.

With new ADA requirements, it is important to check to see if the back of the driveway or handicap ramp will have to be dropped down in relation to the back of sidewalk grade. If so, a gradual flattening or warping of the sidewalk may be desirable to provide a smooth transition. Drainage should flow out through the driveway or ramp rather than onto private property.

- *Joints* in sidewalks and driveways are not usually shown on the plan. Joints should be transverse to the line of work and at regular intervals not more than two times the sidewalk width, or 15 feet on center. (See Exhibit 12-5.) Sidewalks wider than 10 feet should have a longitudinal score line(s).

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- *Scoring* sidewalks is shown in Standard Plan P-551 or specified in District Guidelines. Specialized scoring patterns are required in certain districts such as Lloyd Center District, River District, and South Waterfront District.
- *Concrete work* around water meters, gas valves, street lighting, fire hydrants, and traffic signals should be coordinated with the appropriate agency of jurisdiction.
- *Surface finishes* should be a light to medium broom finish. 00759.50
- *Concrete splatter* should be avoided on existing features such as buildings, curbs, streetlights, fire hydrants, etc. All splatter should be cleaned before it hardens and becomes difficult to remove.
- *ADA Standards* Building ADA ramps on steep hillsides can be a real challenge. They can be made to work if designed properly and staked properly by surveyors. Sidewalks can be warped gradually for a smoother transition.
- Fitting new ADA ramps to existing (tight) conditions can also be challenging. The Inspector should do a field check for obstacles or existing doorways requiring field fit matching not anticipated by the designer and make suggestions for modifications to better fit the site. Look carefully at existing street grades and drainage conditions. Will it drain properly?
- Minor field adjustments or modifications can be made by the Inspector to match up better with existing conditions, as long as ADA requirements are being met. The Construction Manager should be informed of any changes on a timely basis.

Concrete Walls

Work on a concrete wall should begin only after line and grade have been established by the survey crew. Forms should be erected and inspected and the finish grade should be established before placing concrete.

The soil where footings will be placed should be free of loose soil or water and should be checked for soft areas. Any unsatisfactory conditions should be reported to the Construction Manager. All loose material should be removed before placing reinforcement.

Forms should be inspected for strength, rigidity, correct dimensions, tolerances, and aesthetic appearance. Wood form material used on the face of the wall will show all imperfections, joints, holes, warp, etc. Other materials may be used to form a wall, including metal and plastic. Forms should be designed so they can be easily stripped without damaging the concrete.

It is necessary to vibrate concrete during wall construction to remove voids and air pockets from the face of the wall. This operation should be carefully monitored to verify vibration is properly consolidating the layers or lifts of concrete to eliminate segregation and prevent voids. Vibrators may be internal or external designs. Forms need to be specifically designed to accept a clamp-on vibrator. A standby vibrator is **required** to be onsite in the event of a breakdown.

The Inspector should check the following during wall construction:

- Correct location per survey stakes and dimensions according to the plans.
- Staggered joints in sheathing or plywood.
- Form coating applied prior to installing reinforcement.
- Correct reinforcement size, type, proper splices, bends, spacing and clearances.
- Proper number of tie rods, form bracing, and adequately tied corners.
- Locations of control joints, expansion joints, weep holes, and/or embedment.

END OF SECTION 12

CONCRETE: INSPECTOR'S CHECKLIST

Preparation

- Check for completion of site work, grading operations, underground construction, and utility clearance before beginning any concrete work.
- Determine if stamping for preservation of historic information is required; review the process with the Contractor.
- Verify that the proper base and sub grade preparation has been done. Check for firmness of the grade and for proper elevation for thickness required.
- Verify that the locations of all construction joints and other limits of concrete placement have been determined and approved. Determine if keyways are required.
- Check that forms and headers are set at the correct horizontal and vertical alignment, elevation, contour, etc. and they are rigid and straight.
- Check that all manholes, inlets, junction boxes, or other items are firmly set and/or correctly adjusted prior to concrete placement.
- Check if joining of new concrete to old work can be properly performed.
- Check for compliance to ADA Standards at driveways and wheelchair ramps. Will the back of the driveway or ramps need to be adjusted to meet ADA slope and width requirements? Use a smart level to check slopes.
- Verify that the proposed concrete mix is an approved mix. Determine what finishes will be required for the project.
- Make sure the problems caused by hot and cold weather conditions have been considered.
- Schedule testing with the Materials Lab as needed. Notify the lab at least 24 hours in advance.
- Check that the sub grade has been dampened prior to placement.
- Ensure that provisions have been made for curing the concrete.

Concrete Placing and Finishing

- Check delivery tickets to determine if it has an approved mix number and the time it was loaded. Check the mix design strength and any admixtures are in compliance with the project specifications and intended use.
- Monitor that slump tests and test cylinders specimens are prepared according to the sampling and testing schedule. Visually inspect the concrete slump and compare to the slump value when the actual test is taken.
- Observe the concrete mixture as it is placed. Is the general appearance and consistency satisfactory? Is the concrete being deposited properly?
- Ensure that spreading, consolidation, and screeding is done without delay.
- Do not allow concrete to be poured over nuts on hydrants or pole bases. Maintain a 2-inch minimum clearance.
- Check if concrete has been adequately vibrated and consolidated.
- Check that all curb spreaders are being removed as the concrete is placed.
- Check that preparations are completed and materials are available for joint installation during concrete placement. Is joint layout established?
- Verify that expansion joints are located and edged.
- Verify that weakened plane joints are installed and edged.
- Check surface after first floating operation for highs or lows. Use a straight edge and fish line, if required.
- Check edging and scoring operations for proper workmanship.
- Check finish and texture. Over-troweling is to be avoided.
- Check the method for curing the concrete. Is the curing compound thoroughly mixed and applied at the approved rate?
- Check that the work is protected with barricades, fences, & construction tape.

Concrete Paving

- Review with Contractor the specifications, thickness, spacing and type of joints, lane widths, and finish texture, etc.

- Verify the Contractor has scheduled all required testing.
- Ensure that all vault and meter boxes are set to grade and parallel with the curb.
- Perform a string line or straight edge check for grading in center areas of slab.
- Determine if the side forms are proper strength, on grade and alignment.
- Check if any block outs are required for utilities.
- Determine if any steel reinforcement or other embedment are required.
- Make sure curing compound is applied immediately after texturing.
- Ensure that joint methods and materials are provided and observed. Check joint sawing operations for layout and sequence. Is the timing of saw cutting correct? Are width and depth per plans? Is saw cut flushed and cleaned out?
- Determine if joint sealing compound is required.
- Make sure pavement is protected with barricades and/or fences

Curb and Gutter Construction

- Check integral curb and gutter forms for batter of the curb and slope of the gutter. Check height of curb face (exposure) and top of curb width. Check the gutter width and thickness.
- Check curbs at all critical locations, i.e., the PT, PC, PRC, grade breaks and vertical curves. Recognize that curb forms are tangent and some allowances must be made for tight curves.
- Verify vertical curve areas so the finished curb elevations are correct and will properly drain as designed.
- Ensure that curb endings are provided where needed, even if not marked on plans.
- Make sure driveways and ADA ramps are blocked out for monolithic pour.
- Make sure water meters, valves, vaults, and hydrants are located behind curb, and set to finish grade.
- Check the curb alignment after the front form is stripped and ensure that the curb is straightened if necessary. Check the back edge alignment.

- Determine if a keyway is required for adjoining sidewalks.
- After concrete placement, check for alignment, grades, depth, the slope of the curb, finish, and edge expansion joints on the face of the curb.
- Verify that the mold used in the slip form curb machine corresponds with the type of curb for the project plans (including keyway or shelf when required).
- Make sure the slip form curb machine will maintain grade by checking the string line for sensor and track setting.
- After extrusion, check the shape for accuracy, using a level and hand rule; check for alignment and sag before the concrete sets. The line and grade string can be checked to the survey points, but the final checking should be done immediately behind the extruding machine.
- Check the final finish of the curb and gutter. Cross slope at top of curb? Joints edged? Curb face finish?
- Verify that contraction joints are properly constructed and edged.

Sidewalk, Driveway, and Ramp Construction

- Check that forms are set & braced securely, with full bearing on the sub grade.
- Check the thickness of the slab. Make sure water meters, valves, vaults, are adjusted to finish grade.
- Check sidewalks and driveway connections for alignment, scoring, finish.
- Check if tree wells, streetlights, and traffic signals are blocked out. Are others required for uncompleted work?
- Verify that driveway locations, styles, and sizes are correct and fit the site.
- Check monolithic driveway construction for slope, bottom width, and lip at the street gutter.
- Make sure telephone, power pole locations, and guy wires are located correctly to allow a minimum 4-foot clearance for wheel chair passage along the sidewalk.
- Check the precise tolerance for handicap access ramps.

- Check to see that the final finishing does not start too soon. The sheen must be gone before the floating, troweling, and brooming operations.

Wheelchair Ramp Checklist

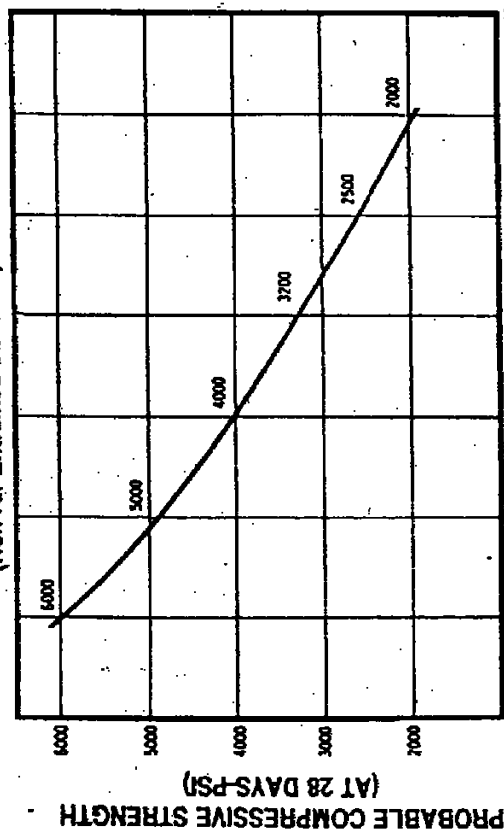
1. Does it meet ADA requirements? 2% by 2% landing, 8.33% maximum ramp?
2. Does it drain properly? Will water puddle at the front of the ramp? Will there be enough cross-slope in the pavement patch? Sometimes you have to adjust grades to make it work.
3. Will joint pattern prevent cracking? Plans are only a guideline unless entire project has a specific scoring pattern shown for corners?
4. Do ramps line up well with existing sidewalks, crosswalks, and ramps across the street? It is okay to move a ramp over or shorten it a little bit to make it fit better to existing conditions.
5. Are there obstacles like poles, inlets, hydrants or signs? Obstacles are okay in wing (but not in throat), if there is at least 4' clearance behind it or around it.
6. Can a person in a wheelchair easily access signal push button for pedestrian crossing?
7. Are approved yellow truncated dome materials properly installed at ramps?

TIME TABLE OF CEMENT STRENGTHS (PERCENT*)

Cem. Type	3 Days	7 Days	14 Days	28 Days	60 Days
I	40	60	80	100	
II	33	55	65	80	100
III	60	80	100	120	
IV	20	40	55	75	
V	20	40	60	80	

*Compressive strength rated on percentage of Type I 28-day strength
(All types increased in one year 133%)

EFFECT OF WATER CONTENT ON COMPRESSIVE STRENGTH OF CONCRETE (Non Air Entrained Concrete)



WATER CEMENT RATIO—GALS. OF WATER PER BAG OF CEMENT
From ACI 613: ACI Recommended Practice for Selecting Proportions for Concrete

Exhibit 12-1
CONCRETE STRENGTH TABLE

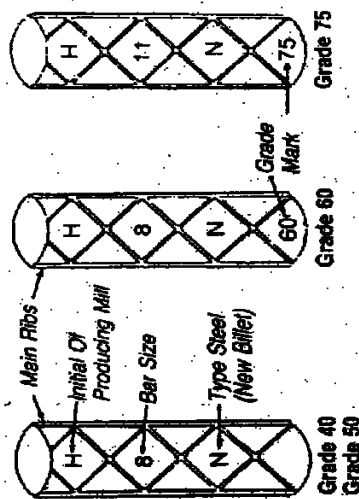
Reprinted from *Public Works Inspector's Manual*,
Building News Book, 3055 Overland, Los Angeles, CA 90034

COMMON TYPES OF STEEL REINFORCEMENT BARS

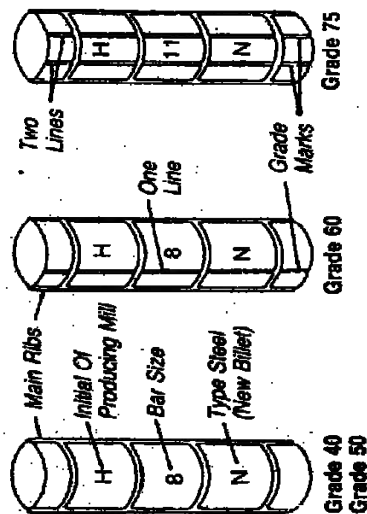
ASTM specifications for billet steel reinforcing bars (A 615) require identification marks to be rolled into the surface of one side of the bar to denote the producer's mill designation, bar size and type of steel. For Grade 60 and Grade 75 bars, grade marks indicating yield strength must be shown. Grade 40 bars show only three marks (no grade mark) in the following order:

- 1st — Producing Mill (usually an initial)
- 2nd — Bar Size Number (#3 through #18)
- 3rd — Type (N for New Billet)

NUMBER SYSTEM — GRADE MARKS



LINE SYSTEM — GRADE MARKS



STANDARD SIZES OF STEEL REINFORCEMENT BARS

Bar Designation Number*	STANDARD REINFORCEMENT BARS			
	Nominal Dimensions		Nominal Dimensions	
	Nominal Weight, lb. per ft.	Diameter, in.	Cross Sectional Area, sq. in.	Perimeter, in.
3	0.376	0.375	0.11	1.178
4	0.668	0.500	0.20	1.571
5	1.043	0.625	0.31	1.963
6	1.502	0.750	0.44	2.356
7	2.044	0.875	0.60	2.749
8	2.670	1.000	0.79	3.142
9	3.400	1.128	1.00	3.544
10	4.303	1.270	1.27	3.990
11	5.313	1.410	1.56	4.430
14	7.65	1.693	2.25	5.32
18	13.50	2.257	4.00	7.09

*The bar numbers are based on the number of $\frac{1}{8}$ inches included in the nominal diameter of the bar.

Type of Steel and ASTM Specification No.	Size Nos. Inclusive	Grade	Tensile Strength Min., psi	Yield (a) Min., psi
Billet Steel A 615	3-11	40	70,000	40,000
	3-11, 14, 18	60	90,000	60,000
	11, 14, 18	75	100,000	75,000

Exhibit 12-2
STEEL REINFORCEMENT BARS

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WELDED WIRE FABRIC – COMMON STOCK STYLES OF WELDED WIRE FABRIC

Style Designation	Steel Area sq. in. per ft.		Weight Approx. lbs. per 100 sq. ft.
	Longit.	Transv.	
Rolls			
6x6—W1.4xW1.4	.03	.03	21
6x6—W2xW2	.04	.04	29
6x6—W2.9xW2.9	.06	.06	42
6x6—W4xW4	.08	.08	58
4x4—W1.4xW1.4	.04	.04	31
4x4—W2xW2	.06	.06	43
4x4—W2.9xW2.9	.09	.09	62
4x4—W4xW4	.12	.12	86
Sheets			
6x6—W2.9xW2.9	.06	.06	42
6x6—W4xW4	.08	.08	58
6x6—W5.5xW5.5	.11	.11	80
4x4—W4xW4	.12	.12	86

Certain styles of welded wire fabrics as shown in the Table have been recommended by the Wire Reinforcement Institute as common stock styles. Use of these styles is normally based on empirical practice and quick availability rather than on specific steel area designs. Styles of fabric produced to meet other specific steel area requirements are ordered for designated projects, or, in some localities, may be available from inventory.

ASTM SPECIFICATIONS

Welded wire fabric used for concrete reinforcement consists of cold-drawn wire in orthogonal patterns, square or rectangular, resistance welded at all intersections. Welded wire fabric (WWF) is commonly but erroneously called "mesh" which is a much broader term not limited to concrete reinforcement. Welded wire fabric must conform to ASTM A 185 if made of smooth wire or A 497 if made of deformed wire. These Specifications require shear tests on the welds essential to proper anchorage for bond in concrete. ASTM yield strength is 65,000 psi for smooth fabric (A 185) and is 70,000 psi for deformed fabric (A 497).

Unless otherwise specified, welded wire fabric conforming to ASTM A 185 will be furnished.

An example style designation is: WWF 6x12-W16xW8. This designation identifies a style of fabric in which:

Spacing of longitudinal wires = 6"
 Spacing of transverse wires = 12"
 Longitudinal wire size = W16
 Transverse wire size = W8

A deformed fabric style would be designated in the same manner with the appropriate D-number wire sizes.

It is very important to note that the terms "longitudinal" and "transverse" are related to the method of fabric manufacture and have no reference to the position of the wires in a completed concrete structure.

Exhibit 12-3 WELDED WIRE FABRIC

Reprinted from *Public Works Inspector's Manual*,
 Building News Book, 3055 Overland, Los Angeles, CA 90034

1. "Driveway" means a concrete way for vehicular traffic extending from the roadway to the property line across a sidewalk, whether or not such sidewalk is improved, for the purpose of providing access to parking or maneuvering space on abutting property.
2. "Residential driveway" means a driveway serving a one or two family residence.
3. "Commercial driveway" means a driveway serving any property except a one or two family residence.

17.98.110 (Amended by Ord. No. 148471; and 161790, effective Apr. 12, 1989.)
Driveways - Permits and Conditions.
 Upon appropriate application and payment of fees, as provided in Chapter 17.94, the City Engineer may issue a permit to construct a driveway in the street area subject to the following conditions:

1. All driveways shall be constructed according to plans, specifications, and any special conditions prescribed by the City Engineer.
2. Location. No portion of a driveway, including ramps if required, shall be located closer than 25 feet from the corner of a lot where two streets intersect.
3. Width of driveways. A permit to construct a driveway in the street area is subject to the following width provisions:

A. Residential driveway:

Private Property Frontage	Minimum Width	Maximum Width
50 ft. or less	10 ft.	20 ft.
51 ft. to 75 ft.	10 ft.	25 ft.
76 ft. to 100 ft.	10 ft.	30 ft.

If more than one driveway is desired, for frontage up to 100 feet the maximum width of driveways shall be 15 feet with not more than

two such driveways permitted within such frontage, provided however, that no less than 5 feet of straight curb must separate service driveways under one ownership. Each 100 feet of frontage, or fraction thereof, under single ownership shall, for purposes of this Chapter, be considered a separate frontage.

B. Commercial driveway:

Private Property Frontage	Minimum Width	Maximum Width
50 ft. or less	10 ft.	20 ft.
51 ft. to 100 ft.	20 ft.	30 ft.

If more than one driveway is desired for frontage up to 100 feet, the maximum width of driveway shall be 20 feet with not more than two such driveways permitted within such frontage; provided, however, that no less than 5 feet of straight curb must separate service driveways under one ownership. Each 100 feet of frontage or fraction thereof under single ownership shall for purposes of this Chapter be considered a separate frontage.

C. Driveways shall be measured
 lengthwise with the sidewalk on the property line side, and such measurement shall not include the width of ramps extending to the regular sidewalk grade. Ramps, if required, do not constitute part of required minimum or allowed maximum width. Determination of the need or appropriateness of ramps shall be within the sole discretion of the City Engineer.

D. Any driveway at variance with these width limitations shall not be permitted unless the City Engineer specifically approves or requires the same. Any applicant requesting a driveway at variance with these standards shall provide such information as the City Engineer may require in support of the application. The City Engineer may establish conditions deemed necessary to insure the safe and orderly flow of pedestrian and vehicular traffic and the decision of the

City Engineer as to the widths and location of driveways shall be final and conclusive.

4. The City Engineer may refer any driveway permit application to the City Traffic Engineer for a review of the location and width. The City Traffic Engineer shall recommend such conditions and limitations regarding the location and operation of driveways as are in his or her judgment necessary to insure the safe and orderly flow of pedestrian and vehicular traffic.

5. A. The City Engineer may require any applicant for a driveway permit to provide evidence that the proposed driveway will access legal parking and maneuvering space on property as set forth in Title 38, Planning and Zoning regulations. The City Engineer may refuse to issue a permit if the applicant cannot show evidence that on-property parking and maneuvering space is in compliance with Title 38, Planning and Zoning regulations.

B. If the City Engineer finds that a property owner is permitting access where a properly constructed driveway does not exist, the City Engineer may post notice and require termination of access or construction of a driveway in accordance with the requirements of this Chapter.

6. Revocability of driveway permits.

A. The City Engineer may revoke any driveway permit or require the modification of any driveway if:

1. The area occupied by the driveway is needed for the public convenience;
2. Continued operation of the driveway interferes with the safe and orderly flow of pedestrian or vehicular traffic; or
3. The abutting owner has failed to comply with all specifications and conditions of the permit; or
4. The driveway does not access legal parking and maneuvering space on abutting property.

B. The Council may revoke any driveway permit if they deem such action will be in the public interest.

Exhibit 12-6

CITY OF PORTLAND DRIVEWAY PERMITS AND CONDITIONS

Excepted from the Public Improvements
 Section of Title 17 (City Code)

SECTION 13 - ASPHALT PAVING

GENERAL

Asphalt cement is a product refined from selected petroleum crude oils, and produced in a variety of types and grades ranging from hard brittle solids to almost water thin liquids. Liquid asphalts are generally prepared by blending asphalt cements with petroleum distillates, volatile solvents, or by emulsifying them with water.

The cementitious characteristic of asphalt makes it a widely used product for paving. When mixed with aggregates it is a plastic substance that is flexible yet controllable; when placed and compacted becomes highly waterproof and durable.

The semi-solid form, known as asphaltic concrete is the basic material used in the City of Portland for street construction. In many ways asphalt is similar to concrete, except that strength is gained through compaction of the material rather than through a chemical process.

MATERIALS SAMPLING AND TESTING

See
Section 8

The Inspector is responsible for monitoring the HMAC/MWMAC placement and compaction operation and that asphalt samples are taken as needed. The contractor is responsible for submitting the proper mix designs to be used. The contractor will be responsible for all sampling and testing on contract projects. All technicians doing the testing must be ODOT certified. The type and frequency of these tests, and information about Job Mix Formulas (JMF) can be found in the ODOT Field Test Procedures manual.

HOT MIXED ASPHALTIC CONCRETE (HMAC)

00744

Hot Mixed Asphaltic Concrete is a high-quality, thoroughly controlled hot mixture of asphalt cement and well-graded, high-quality aggregates which, when thoroughly compacted, will create a uniform dense mass.

HMAC is mixed in a central plant, using heated aggregates and paving asphalts. The asphalt cement binds the aggregates particles together. The asphalt cement content in a mix is a function of the surface area, roughness, and absorptive qualities of the aggregate, as well as the type of asphalt cement used. Mixes containing finer aggregate gradations and using the higher viscosity asphalts will tolerate larger amounts of asphalt.

The HMAC material is laid with paving machines or hand spread, and then compacted with rollers to obtain specified densities.

Paving grade asphalts and their uses in aggregate mixtures are as follows:

PG = PAVING GRADE

PG 64-22

PG 70-22

Paving Mix Design and Characteristics

A properly designed paving mixture should have six desirable properties: stability, durability, flexibility, skid resistance, imperviousness and workability. The amount of asphalt incorporated into the mixture should be as much as possible to provide a stable water resistant pavement, but not so much that the stability is reduced and cannot support anticipated loads. Insufficient asphalt in the mix exposes the pavement to water intrusion and raveling, and too much asphalt or fines in the mix produces bleeding and instability.

Adequate strength can be obtained with dense-graded mixes composed of 1/2 to 3/4-inch nominal maximum size aggregates. These mixes will be watertight and reasonably impermeable to air when they are compacted to an average of 8 percent and a minimum of 6 percent air voids.

ASPHALTIC PAVING CONSTRUCTION

A variety of situations can cause imperfections in finished pavements, from the materials used to the workmanship involved. The Inspector should be capable of determining the condition and performance of the materials, methods, and construction equipment used, and is responsible for taking an active role during paving operations by having the necessary tools (a string line, straight edge, level, pocket rule, and thermometer) to perform inspection duties.

Inspection before Paving Operations

Before paving operations begin, the Inspector should check to see that the base or sub-grade is at the proper elevation, true to cross-section, and has been compacted to the required density. The quality of the completed pavement is largely dependent on the condition and accurate inspection of the crown section of the sub-grade, base, and the finished pavement.

After any street has been constructed, reconstructed or paved by City forces, under City contract, or under permit, the pavement surface shall not thereafter be cut or opened for a period of 5 years. Generally the requirements for restoration are:

1. A single lane that is impacted shall have full pavement restoration for the width of the lane.
2. If multiple lanes are impacted, the full width of all lanes affected shall be restored.
3. Impacted bike lanes shall be restored in their entirety.

Line and Grade

The Inspector should check elevations of the base rock by stringing at 100-foot intervals at the centerline, both 1/4 points, and both curbs. They should measure between the Contractor's set of controls. Allowable tolerance is plus or minus 1/2 inch. Irregularities must be corrected before subsequent pavement courses are placed.

00640.44

Underground Utilities

All underground work should be completed before placing asphalt pavement courses; manholes, inlets, and other structures must be adjusted to final grade. Structures set to final grade should be checked during paving to assure that the lids are in the correct location and paving material has not entered the structure.

See
Section 7

Tack Coat

Tack coats are applied when HMA CMW MAC lifts are placed over existing pavement. The purpose of a tack coat is to assure a good bond between the new paving material and the surface of existing pavement. No tack coat is required when placing pavement over a rock base or when paving the second lift shortly after paving the base lift.

00730

Emulsion-type tack coats applied to damp surfaces can be used in hot or cold weather. Hot asphalt tack coats are seldom used on City streets, but when used must only be applied to dry surfaces. When applying a tack coat over existing pavement, the surface should be washed and broomed. Cleanliness and dryness of the existing pavement is important. If using emulsified asphalt, the contractor may elect to dilute the tack coat with water to a maximum 1:1 ratio. Determine the proportion of water to be added to emulsified asphalt. Do not dilute the emulsified asphalt until the Engineer approves the dilution ratio. Add the water to the emulsified asphalt and mix according to the asphalt supplier. Make sure that the diluted tack completely turns black before any hot mix asphalt has been placed. If this diluted tack has not turned black the hot mix will not stick to the existing pavement. The water used to dilute will evaporate and turn the brown color black.

A tack coat is used to cover individual particles on an existing surface and prevent these particles from later taking asphalt from the paving mixture and creating a slippage plane. If this coating is too scant, the effectiveness is reduced and the pavement may ravel or peel off. If the tack coat is excessive, it over-lubricates the surface and creates a slippage plane, and may also result in bleeding and instability of the new pavement.

As a rule of thumb, a tack coat should be applied only in such quantity as to fog coat or speckle the surface. The Inspector should check for the following:

- Work should be planned so that the paving mixture can cover the area treated with

tack coat within the same day.

- All nonessential traffic should be kept off of tack-coated areas.
- The tack coat should be applied where the mixture contacts the vertical faces of curbs, gutters, cold pavement joints, and "feather-edge" joints or skin patches.

00495.40

Weather Conditions

AC pavement mixtures should not be laid at atmospheric temperatures below 40 degrees F without permission from the Construction Manager. Ambient temperature has a marked effect on compaction results. The lower the air temperature, the faster the mix cools and therefore less time for compacting it adequately. A cold wind can have similar results and can also create a crust on the surface of the mix.

00744.40

The temperature of the mix should be checked against the specifications at the time the mix is delivered to the job site. More information on mix temperature during compaction can be found at the end of this section.

It is permissible to pave the base lift in light mist, but there can be no standing or running water. The top lift should not be placed if it is raining or the pavement is damp. If you are paving and the weather changes be sure to communicate with the paving foreman about stopping placement of asphalt. If this happens, be sure to place the asphalt that has been loaded. This includes trucks that are in transit with covered loads.

Transport and Delivery

The Inspector and the Contractor's QC personnel should check the delivery tickets to verify that the proper type of mix is being supplied. A mix may be rejected if it is observed to be defective. Some of the reasons for rejecting a mix are:

00744.16

- **Too hot (over 325°F):** Overheated mixes can be identified by blue smoke. The temperature should be checked with a thermometer to see if it is within the specified placing temperature.
- **Too cold (under 240°F):** If the mix is too cold, it will appear to be "stiff" or the aggregate may be only partially coated. The temperature should be checked with a thermometer to see if it is within the specified placing temperature.
- **Non-uniform mixing:** An improperly mixed batch will appear patchy, with areas of brownish, dull material intermixed with shiny black material. It can sometimes be detected while still in the truck and should be rejected.
- **Miscellaneous:** Other unacceptable conditions include segregation of the aggregates within a batch or contamination of the mix by debris, trash, dirt, etc.

Paving Machines

Mechanical pavers are required on all jobs, except when an area is irregularly shaped or a limited size, warranting the use of a spreader box or spreading by hand.

Paving machines are self-propelled and are equipped with a hopper, spreader screws, screed, and tamper mechanisms. These machines can produce a high-quality pavement however, continuous and consistent operation and the condition of the equipment are important to ensure properly laid pavement.

The operation of paving machines should occur with as few starts and stops as possible to ensure a smoothly spread mixture. The Inspector should be able to determine which operating conditions may result in substandard pavement and be prepared to call such conditions to the attention of the Contractor for correction. Some of the problems that may be encountered with paving machines and their operation are:

- When the paver is operating at high speeds, problems such as the screed bar dragging the surface and pulling transverse cracks into the pavement become aggravated. Reducing the travel speed will alleviate this.
- Frequent adjustments of the screed controls results in a rough pavement. For most mechanical pavers, adjusting the screed for lift thickness cannot be effected immediately. The paver must travel at least 8 to 15 feet in order for a change in the screed setting to occur. If the subgrade is properly prepared, the screed controls should be set and adjusted at the beginning of paving operations, and then minor adjustments can occur if necessary.
- The paver speed should be regulated to place asphalt at a rate consistent with the supply. If the machine stops to wait for a supply truck, the working parts will cool off and the mix will stiffen.
- Trucks backing up to dump their loads should be careful to minimize any impacts to the paver. Heavy impacts will rock the paver backward, causing a bump in the pavement.
- The hopper of the machine should not be overloaded or paving material allowed to spill onto existing adjacent pavement.
- The hopper should never be completely empty except at the end of the day because an empty hopper will cause the machine to "ride up."
- The paving mixture should be kept from accumulating on the side of the hopper. When cooled, this material could scale off onto the conveyor and pass into the pavement. The operator should never lift the wings on the paver causing the cold asphalt to be incorporated into the hot mix.

- Hand raking of joints in conjunction with mechanical spreading should be kept to a minimum to achieve a uniform texture. If the operations ahead of the paver are properly performed and the equipment is in good condition, there should be little need for hand repair work.

Hand Spreading

Hand spreading paving material is permitted when mechanical spreading is either impractical or inaccessible. After the material is deposited, it may be shoveled into place, leveled with lutes, and compacted with a vibrating plate compactor or small roller.

The Inspector should check for the following during hand spreading:

- Care should be exercised to avoid segregation of the coarse aggregate during hand spreading.
- Any footprints in the loose material should be re-raked.
- Lumps that form should be loosened, and spreading should occur only with lutes or rakes.

Lift Thickness

To allow for compaction of the loose paving material, the Inspector should require 25 percent (or 1/4-inch per inch of lift thickness) to be added to the required pavement thickness. The thickness of each course should be checked before additional courses are laid.

The Inspector should check elevations of the asphalt by stringing at 100-foot intervals from curb to curb to the centerline and at both 1/4 points. Allowable tolerance is plus or minus 0.03 feet, as amended by the special specifications.

The Inspector should occasionally compute the area that has been covered against the total tonnage of the material delivered as a cross check to determine if sufficient material has been placed. (See Exhibit 13-1)

A leveling course should be laid to fill low places in existing pavement before subsequent AC pavement lifts are laid.

Joints

All joints should be staggered approximately 6 inches between courses, both longitudinally and transversely. Longitudinal joints should be minimized as much as possible. The most satisfactory joints are made with the subsequent lane overlapping the previous lane and the overlapped material left in place. This overlap should be pinched quickly after

placement, with most of the roller on the first lane placed. Placing joints in the wheel path should be avoided.

Compaction

Pavement strength is gained through compaction by rollers. Rolling the asphalt paving mixture develops its strength and resistance to abrasion, develops cohesion and stability, and reduces voids which would permit air and water intrusion.

00744.49

Water infiltration increases the moisture content of the sub-grade and base rock, causing a reduction in strength and resulting in pavement settlement and cracking. When too much air penetrates a poorly compacted pavement, it causes oxidation and hardening of the asphalt cement, resulting in a shorter pavement life.

The void ratio after rolling is important. Some voids are needed or the pavement will be unstable and will "bleed."

Compaction by rolling the paving mixture occurs in three stages: breakdown, intermediate, and finish rolling. Almost all the density achieved in the pavement is produced during the breakdown and intermediate rolling stages. Finish rolling produces very little densification. Final compaction is usually achieved when the mat has cooled to approximately 160 degrees F. Finish rolling after the mat has cooled is done to roll out creases and other equipment marks. The finish roller should never vibrate the mat which causes tearing and produces an uneven mat.

Compaction rolling is achieved with a steel-wheeled or a rubber-tired roller. Steel-wheeled rollers may be the static or vibratory type. Finish rolling is usually done with a steel-wheel static roller to iron out any roller marks or longitudinal grooves.

The principal factors affecting the density obtained during rolling are:

- The temperature of the mix during compaction.
- The thickness of each lift of HMA.
- The contact pressure between the roller drum or tire and the mat.
- The number of passes made by the rolling equipment.

Temperature

The temperature of the mixture when rolled is critical. If the mix is too cool, not enough compaction will be obtained. If it is too hot, the roller can damage the surface. To aid the Inspector, Exhibit 13-2 charts the approximate cool-down time required for laydown temperatures for HMA.

Compaction operations should start at as high a temperature as possible because density can be obtained with fewer passes at this temperature than at lower temperatures. The "highest temperature possible" varies with different mixtures. Low temperature mixes should be rolled quickly after laydown if the specified density is to be achieved. Mixing temperatures higher than needed to achieve a laydown temperature of 325°F will harden the asphalt and reduce the pavement life. Check the mix design for the mixing and placement temperatures.

Typical **minimum** temperatures for the mixture during the three rolling stages are:

1. Breakdown 240°F

The breakdown pass should be made as soon after laying the mixture as possible without cracking the surface or picking up material on the roller. The greatest percent of compaction is ultimately achieved during the breakdown pass.

2. Intermediate 180°F

During intermediate rolling when laying a pass adjacent to a previously laid pass or existing pavement, the longitudinal joints should be rolled immediately behind the paver, with a rear wheel of the roller extending not more than 6 inches across the joint onto the new paving mixture.

3. Finish 115°F

Finish rolling should not occur until material has cooled sufficiently to avoid leaving marks from the roller tires. (A clue to the proper time to proceed with finish rolling is when a bare hand can be placed on the surface of the pavement without excessive discomfort.)

Contact Pressure

The contact pressure between the mat and roller, rather than the weight of the roller, affects ultimate density produced during rolling. This is because rollers will sink into the mat until the contact pressure equals the bearing capacity of the mat. This is true for both steel-wheeled and rubber-tired rollers; however, steel wheels will not deform, whereas flexible rubber tires will.

On rubber-tired rollers, tire pressure is important. The desired tire pressure is the highest pressure possible to achieve density with the least number of passes, yet not shove the mix too much. This varies with the mix design, and can only be determined on a trial basis.

In order for the roller to compact the mix, it must have enough strength to resist displacement out from under the roller. Rollers with large diameter drums are preferred because they can get on the mix sooner (while it is hotter) without shoving the mix. A roller with a dead drum will also tend to shove the mix, so equipment with all powered drums is preferred, or the power wheel should be forward to knead the mix under.

Compaction Equipment and Coverage

The number of rollers required depends on how fast an area is laid rather than how much material is placed. How fast a given area is laid depends upon paver speed and the width being laid. Both speed and width must be considered when determining the number and type of rollers needed.

Vibratory rollers have been successful in reducing rolling time because more density is produced with each pass of the vibrating drum and their wider drums require less time to cover a given area.

The successful operation of vibratory rollers requires an understanding of frequency and amplitude. Roller drum vibrations are produced by off center weights (eccentrics) on a spinning shaft. Vibration frequency is the number of downward impacts or vibrations per minute. The weights of the eccentrics, their distance from the shaft, and the weight of the drum, comprise the amplitude, which may be identified on rollers where this is adjustable as "low," "intermediate," or "high."

On thin lifts (up to 4 inches thick), high frequency and low amplitude with a controlled roller speed will give the best compaction results. As the roller moves ahead, the vibrating drum produces rapid impacts on the surface of the mix. These impacts produce pressure waves of equal frequency that cause the particles to move closer together, densifying the mix.

Roller Operation and Procedures

It is important for the Inspector to observe and be knowledgeable about the following procedures during rolling operations:

The paving mixture should be rolled at the proper time and temperature. Placement of the second course should not occur until after the first course has cooled to the extent that it does not displace under equipment.

The roller should be the appropriate type and weight to achieve specified densities and produce a smooth surface. Roller speed should not exceed 3 mph for steel-tired rollers or 5 mph for pneumatic-tired rollers. The Standard Construction specifications will indicate the minimum size requirements for rollers.

Proper operation of the roller must be maintained. Breakdown and subsequent rolling should always be accomplished with the drive wheel forward in the direction of the paving, except on steep grades.

Rollers should not be reversed suddenly, reversed at the same point on the mat, or permitted to stand in one place on hot pavement. These events cause indentations that are extremely difficult to remove.

The rolling sequence should give top priority to thin edges or "feather edges." Rolling should start at the gutters and progress toward the crown.

Care should be exercised to avoid excessive rolling of thin lifts during the breakdown and intermediate stages. This tends to break the bond with the underlying layer and cause separation of the mix, resulting in a loss of compaction.

Finish rolling should be performed before the material has cooled to the extent that the rollers become ineffective.

Vibratory rollers used for asphalt paving should have frequencies ranging from 2,000-3,000 vibrations per minute. Lower range vibratory rollers are used for compacting soil and base rock and should not be used on asphalt.

PAVEMENT FAILURES AND TROUBLESHOOTING

Some of the common causes for failure of bituminous pavements are listed below and in Exhibit 13-3. The Inspector should learn to evaluate and recognize the causes of pavement failures to avoid similar problems recurring in new work.

- ***Weathered or dry surface:*** When this condition appears on relatively new pavement, it is generally attributed to insufficient asphalt in the mix. Seal or fog coats may be applied, with the approval of the Construction Manager, to renovate the pavement. The Inspector should check the mix ticket and the condition of the mixture when delivered to avoid this situation.
- ***Potholes:*** Nearly every cause of pavement failure will result in potholing. The most common causes are water infiltration, insufficient asphalt in the mix, segregation of the mix, and/or unstable base conditions.
- ***Alligator cracking:*** This type of failure is usually caused by water saturation of soft spots undermining the base support. Insufficient pavement thickness can also cause alligator cracking. The Inspector should check the condition of the sub-grade prior to paving operations and monitor pavement thickness and watch truck wheel loading to prevent this from occurring.

- ***Bleeding and instability:*** This is almost always caused by excessive asphalt in the mixture or the cumulative effects of asphalt from the mixture, tack coat, seal coats, or fog coats. This condition will result in pavement that has an inclination to creep and is unstable. The Inspector should check the mix ticket and the condition of the mixture when delivered to avoid this condition. The condition of the sub-grade should also be checked prior to paving.
- ***Raveling:*** Raveling is a result of a lean or overheated mix, or it may occur where a skin patch is laid over an improperly prepared area. To avoid this problem, the Inspector should make sure the surface is cleaned, dry, and properly tack coated. A fine mix will assist in feathering the edges. In some cases raveling can be remedied by applying seal coat or sand seal, if approved by the Construction Manager. For large skin patch areas, a modified mix may be specified to prevent raveling.

A cold wind can cause the surface layer to cool too quickly before materials can bind together, causing bony areas and surface raveling which can significantly reduce the life of the pavement.

- ***Erosion of the surface:*** This is caused by water running or standing on pavement for prolonged periods of time while under traffic. This is a design problem that can only be eliminated by construction of storm drain systems and cross gutters. Construction of new bituminous pavement which will obviously impound water should be avoided. If this appears to be the situation, the Inspector should notify the Manager.
- ***Longitudinal and transverse cracking:*** This is generally caused by the contraction of the base or sub-grade and almost always will correspond to cracks in older existing pavement. It is difficult to prevent these cracks from forming, but it is helpful to clean and reseal existing cracks where new pavement is to be laid. Recent geotextile products may be specified if cracking of a paved area is anticipated.
- ***Distortion and depression:*** These failures result from inadequate compaction of the sub-grade or base. The Inspector should be vigilant during sub-grade and base preparation to ensure that proper compaction is being performed.

END OF SECTION 13

HOT MIX ASPHALT PAVING: INSPECTOR'S CHECKLIST

Preparation

- Check plans and specification for pavement type, thickness, number of courses, and other project requirements.
- Review construction procedures and project requirements with the Contractor. Make sure that they have notified residents of access restrictions.
- Inspect the aggregate base course. Has it been checked for grade, cross-section, and compaction? Look for loose, boney, or segregated base rock.
- Check to see that all the underground work has been completed. Are manholes, valve boxes, utility crossings and services visibly marked and adjusted to finish grade?
- Ensure that contact surfaces and joints are properly prepared. The tack coating should cover all vertical surfaces and skin patch areas.
- On pavement overlay areas; check fills for variation and thickness to determine the necessity for a leveling course. Check for broken pavement that should be removed. Square up edges.
- Verify that the existing pavement is trimmed and surfaces cleaned before application of the tack coat.
- Check for good coverage of the tack coat. Is it properly applied to gutter edges and pavement joints?
- Verify that sampling and testing is being performed.
- Ensure that weather conditions are conducive to proper paving operations.
- Check the delivery ticket for the proper JMF number. Does the mix appear satisfactory? Check the general appearance while the batch is still in the truck.
- Schedule testing with Materials Lab as needed. Notify lab at least 24 hours in advance.

Spreading

- Ensure that the speed of the spreading machine is matched to the rate of delivery from the plant.

- Verify that the direction of spreading is correct. Check the operation of the mechanical spreaders. Is the screed contour set properly? Is the thickness of the mat correct? Is joint overlap correct?
- Check the surface appearance behind spreaders or when hand spreading. Is the texture uniform? Is there evidence of segregation or poor mixing?
- Check for the source of any irregularities in the surface and have corrections made. Try to minimize any hand raking when using spreading machines.
- Check the grade and depth of pavement as it is being laid. Check the location of the crown and joints. Look at the slope along gutters and the drainage at inlets, corners, and intersections for potential puddle spots. String line from curb to curb to check the 1/4 points and centerline.

ROLLERS AND COMPACTION

- Check the type, weight, and number of rollers to make sure they meet the requirements and are appropriate for the job.
- Ensure that temperatures are acceptable for rolling and the breakdown pass is performed as soon as permissible. Minimum temperatures for the breakdown pass, intermediate rolling, and finish rolling are 240°F, 185°F, and 115°F, respectively.
- Evaluate operator performance. Is the roller being operated smoothly and at the proper speed? Is the roller being operated consistently--smooth starts, stops, and reversing? Is the roller prevented from standing on hot pavement?
- Ensure that the rolling sequence pattern and coverage are satisfactory. Are skin patches and feathered edges rolled before cooling? Are passes overlapping correctly?
- Ensure that new pavement is barricaded against traffic during construction until it has thoroughly set and cooled.

NOTES

LENGTH OF ASPHALTIC CONCRETE SPREAD ON A ROLLED ROCK BASE
FOR ONE TON OF MATERIAL
CITY OF PORTLAND—DEPARTMENT OF PUBLIC WORKS

THICKNESS INCHES	WIDTH OF SPREAD					SQ YDS/TON
	8 FT/TON	9 FT/TON	10 FT/TON	11 FT/TON	12 FT/TON	
1	17.4	15.2	13.8	12.4	11.4	15.164
1 1/2	12.8	11.4	10.2	9.3	8.5	11.388
2	8.5	7.6	6.8	6.2	5.7	7.592
2 1/2	7.3	6.5	5.8	5.3	4.9	6.52
3	6.2	5.5	4.9	4.5	4.1	5.45
3 1/2	5.3	4.7	4.2	3.8	3.5	4.676
4	4.6	4.1	3.7	3.4	3.1	4.135

**Exhibit 13-1
ASPHALTIC CONCRETE COVERAGE
CONVERSION CHART**

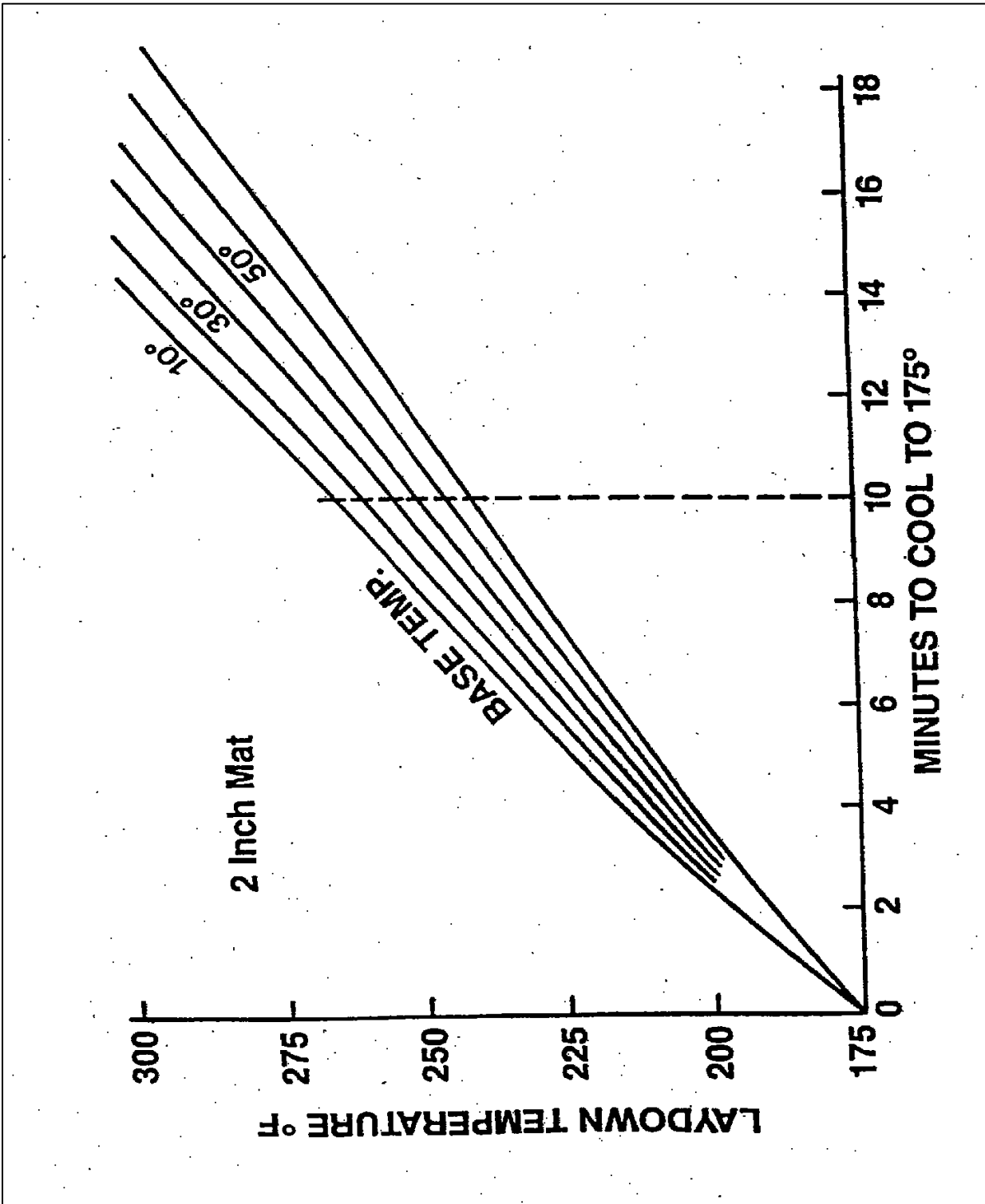


Exhibit 13-2
PAVEMENT LAYDOWN TEMPERATURE CHART

Possible causes of imperfections in finished pavements

Insufficient or Non-uniform Tack Coat					X				X									X
Improperly Cured Prime or Tack Coat					X				X									X
Mixture Too Coarse					X	X	X	X								X	X	
Excess Fines in Mixture					X				X	X	X							X
Insufficient Asphalt					X				X					X				X
Excess Asphalt	X			X					X	X								X
Improperly Proportioned Mixture	X			X	X	X	X	X	X	X	X			X	X	X		X
Unsatisfactory Batches in Load	X			X	X	X	X	X		X								X
Excess Moisture in Mixture				X						X								X
Mixture Too Hot or Burned				X														X
Mixture Too Cold					X	X	X	X	X							X	X	X
Poor Spreader Operation					X	X	X	X		X						X	X	
Spreader in Poor Condition					X	X	X	X		X						X	X	
Inadequate Rolling					X	X	X	X	X									X
Rolling at Wrong Time					X	X	X	X	X	X	X					X		X
Over-Rolling					X								X	X	X			X
Rolling Mixture When Too Hot					X	X			X	X	X	X				X		
Rolling Mixture When Too Cold					X	X	X	X	X									X
Roller Standing on Hot Pavement						X				X								X
Overweight Rollers						X				X	X	X	X	X	X			X
Roller Vibration						X					X							X
Unstable Base Course						X		X		X	X	X				X	X	X
Excessive Moisture in Subsoil														X	X			X
Excessive Prime Coat or Tack Coat	X			X														X
Poor Handwork Behind Spreader						X	X	X	X									
Excessive Hand Raking						X	X	X	X			X						
Labor Careless or Unskilled						X	X	X	X	X								
Excessive Segregation in Laying						X	X	X	X	X								X
Faulty Allowance for Compaction										X								
Operating Finishing Machine Too Fast						X	X											X
Mix Laid in Too Thick Course																X		
Traffic Put On Mix While Too Hot																X		

Types of Pavement Imperfections
That May Be Encountered in
Laying Hot Plant Mix
Paving Mixtures.

Surface Slipping on Base

Tearing of Surface During Laying

Roofs Broken by Roller

Cracking (Large Long Cracks)

Cracking (Many Fine Cracks)

Pushing or Waves

Roller Marks

Uneven Joints

Honeycombed or Raveling

Rough Uneven Surface

Poor Surface Texture

Rich or Fat Spots

Brown, Dead Appearance

Bleeding

Exhibit 13-3 PAVEMENT FAILURES AND TROUBLESHOOTING

SECTION 14 - PROJECT CLOSEOUT

This section identifies activities relating to project completion and acceptance.

FINAL INSPECTION AND PUNCH LIST

When a project is substantially completed, the Inspector and Construction Manager make a final inspection and either accept the work or make a list of required corrections (the punch list). When all punch list items have been corrected, the project is accepted and a certificate of completion is sent to the Contractor and/or permittee. The steps involved in this process are described below.

Cleanup and Restoration

Before the final inspection takes place, the Contractor must do the work necessary to restore and clean up the site and remove all construction equipment, refuse, and unused materials resulting from project activities.

00140.90

As identified in the Standard Construction Specifications, these requirements include:

- Removal of construction materials and debris
- Fine grading of earth berm (raking out rocks 1-inch and larger)
- Cleaning drains
- Cleaning and restoring roadway surfaces
- Restoring curbs, sidewalks, and driveways
- Removal of signs (only as directed)

Final Inspection

The purpose of the final inspection is to verify that the final project conforms to the project plans and specifications. The Inspector and Construction Manager conduct this inspection. Before it takes place, the Inspector should review the project plans and specifications so they are fully familiar with the project requirements.

The final inspection should not be scheduled until the work is substantially complete and the punch list can be limited to a few minor items. The Inspector should walk through the project with the Contractor to establish that the job is ready for final inspection. The final inspection should be done as soon as possible after determining that the job is substantially complete; and the punch list has been requested. On contract projects, it must be done within 15 days.

Final inspection requires walking the entire project area to review it for compliance with the plans and specifications. The Inspector should identify any discrepancies in the work, such as omissions, incorrect dimensions, broken sidewalks, chipped curbs, or form boards to be removed. They should check that items such as guardrails, fences, and mailboxes are installed where required.

The Inspector should see that every sewer and storm drain manhole on the project is opened to check that no dirt, debris, or paving materials have collected in them and to ensure that the rings have not been knocked loose during the paving operations.

If a project includes streetlights or traffic signals, the project cannot be accepted until these systems have been tested and found acceptable by the BTSM.

**See
Section 4**

The following list shows items that the Inspector should be sure to check. This list is not exhaustive, but identifies areas that should be given particular attention.

- Check all notes on the project plans for special features.
- Check for broken or chipped concrete caused by the Contractor's actions (not normal contraction cracks).
- Look for drainage problems.
- Make sure the project is clean (no debris in the right-of-way, clean storage/staging areas, all berm raked to remove rocks and clods larger than 2 inches).
- Check inlets for:
 1. Clean, sloped bottom
 2. No puddles in gutter nearby
 3. Weep holes open and working
- Check manholes for damage caused during grading and paving.
- Make sure all forms have been removed from concrete work.
- Check that all contract items are complete.

Punch List

The Construction Manager is responsible for making a punch list of items that need correction. The punch list should include any necessary repairs and any work that is not considered to be in conformance with the plans and specifications, such as incorrect construction, wrong location, poor appearance, improper functioning, defects, or incomplete work. The process is similar on permit projects.

When the Contractor/permittee has completed the punch list items, they are supposed to notify the Office and request a final punch list inspection. This does not always occur, and the Inspector should monitor jobs that are in the punch list phase. Many projects sit in the files with one or two minor items remaining. A simple phone call to the Contractor or permittee can usually prompt them to take the necessary corrective action.

On contract projects, the special specifications amend the standard specifications regarding time requirements for preparing the punch list. The punch list must be submitted to the Contractor within 15 days after the final inspection. The Contractor has 30 days to correct the punch list items; a penalty may be assessed if they exceed the allowable time.

Final Punch List Inspection

When the Contractor has corrected the punch list items, the Inspector re-inspects the project to ensure that the work has been satisfactorily completed. There is no specified time limit within which this inspection must occur.

An updated punch list is sent to the Contractor with the incomplete items identified on permit projects.

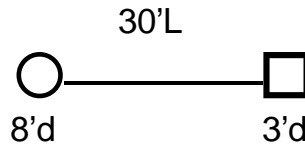
The Inspector signs the punch list form after all punch list items have been satisfactorily corrected. The completion date of all corrections as verified by the Inspector is the date of acceptance. A certificate of completion is then sent to the permittee or Contractor, as well as final quantity estimates for contract projects.

AS-BUILT DRAWINGS

The Inspector is responsible for recording accurate and complete as-built data for every project. As-built measurements must be recorded on clean set of plans in red ink.

The as-built drawings should show any deviations from the original plans and should dimension any items where the plans leave it to the Inspector to establish limits (e.g., limits of full depth paving, limits of skin patches, foundation stabilization, etc). The following items should be included:

- Location and size of all driveways and connections, if different than shown on design plan.
- Manholes and inlets adjusted or reconstructed.
- Inlets moved.
- Length, size, depth, and location of all inlet leads to be marked as follows:
-



- Quantity and location of rock used for driveway connections.
- Additional work not shown on the original plans. (Note whether the property owner paid the Contractor for additional work or the work is to be assessed to the property owner.)
- Amount and location of all rock or other pay material used for soft spots, sewer trenches, drain lines, french drains, etc.
- Location and dimensions of skinpatch areas.
- Station or location limits of full depth construction.
- Parkway and sidewalk widths
- Street crown and X-section.
- Any changes in grade or alignment or other details that have been made from the original design.

For contract projects, a higher degree of as-built information is needed than for permit projects. Sufficient dimensions must be shown to enable all bid items to be calculated.

As-built drawings are done with red ink, must be legible, and should not contain abbreviations that another reader cannot decipher.

The Inspector should review the as-built drawings with the Construction Manager before turning them in to the Office.

OTHER PROJECT CLOSEOUT REQUIREMENTS

The Inspector should perform the following activities when closing out a project:

- **Submit project information to the Manager.** This should include: as-built drawings; material receipt tickets for top soil; documentation for additional work, if any; property owners' requests for additional work, if any; construction authorization forms; sump test reports; any other information pertinent to the job.
- **Check the completed job from time to time.** The Office checks the job at 20 months, but the Inspector should occasionally check it for problems before that time

(e.g., defects such as puddles, slides, or cracks; damage by others or by traffic). The Contractor should be notified of any problems by the Office so the needed corrections or repairs are made within their liability period. The projects that need warranty inspections are given to an Inspector. The Inspector reviews the project in the field, completes the checklist and takes photos of any problems. The project information is returned to the Office for further processing.

END OF SECTION 14

NOTES

SECTION 15 - DOCUMENTATION

This section describes the major project documentation for which the Inspector is responsible: the daily progress report, Installation sheets for progress payment estimates, collecting material tickets and logging and filing photographs and videos.

Other documentation requirements are listed under "Other Documentation," below. Subjects that are discussed in another section of this manual are cross-referenced to the appropriate section.

Examples of all of these documents are contained at the end of this section.

The Glossary in this manual contains a figure showing standard nomenclature for street construction; this should be referred to as necessary to ensure the correct use of terminology in all project documentation.

DAILY PROGRESS REPORT

The daily progress report is the most important piece of paper for a project. In most cases, it will be read and filed and never referred to again. But months or even years later, it may be the only City owned information that can be used to resolve disputes or claims.

The daily progress report should be a comprehensive record of what has occurred on a given day. The reports should be sufficiently detailed to allow the reader to reconstruct the project at a later date. The types of information to include are listed below, and are summarized on the "General Daily Progress Report" form contained in this section. The Inspector should regularly review these requirements to ensure that reports are thorough.

It is also recommended that the Inspector keep up-to-date "As Paid" drawings so double payment isn't likely.

The following guidelines should be used in preparing the daily progress report:

- Complete one report **per day**, contractor working or not.
- **Complete the report on the day the work is done.** The report must consist of daily original entries only; editing is not allowed
- Fill in all applicable items clearly and accurately.
- Make sure the report is legible; printing is preferable. Use colored ink. (not black)
- Reread each report after it is completed to make sure it is understandable.

- Keep the reports factual do not include opinions.
- Be as specific as possible. For example, do not say: "Rock is ready for paving," but rather say: "No spots off more than plus or minus 1/2" when measured at 100-foot intervals."
- If problems or undesirable conditions are noted in one report, document follow-up action or resolution in a subsequent report.
- Turn in reports to the Office a minimum of once a week. A daily progress report must be in the file for every hour charged to a project. Failure to maintain these vital records is grounds for disciplinary action.

Types of Information to Include in the Daily Progress Report

- Project name and number, Contractor, and date of report.
- Number of personnel, major equipment used, hours worked. (Exact numbers are not required; an estimate indicating the general level of activity is sufficient.)
- Factors adversely affecting progress of the work, such as delay in utility work completion, delivery of materials and equipment, unforeseen conditions, strikes, plan changes, poor Contractor management, severe weather and resulting soil conditions, etc.
- Unsatisfactory work performed by the Contractor and corrective actions proposed or taken. Be sure to document all verbal instructions or notice to the Contractor.
- Conditions that may require changes or additional work, or may generate controversy or claims. The proposed methods of handling the situations should be described. Any indications by the Contractor of his intention to file a claim should be reported.
- Unusual or difficult engineering, construction, or traffic problems and their solution.
- Unusual conditions regarding safety. Precautionary measures taken with respect to protecting construction workers, the traveling public, and abutting property from injury or damage as a result of the construction operations.
- All noteworthy discussions with Contractor personnel or with homeowners.
- Accidents and property loss or damage.
- Right-of-way, public utility and public transportation problems.

- Quality of the work produced (workmanship).
- Provisions for movement of traffic, access to property, detours, and signing.
- Causes of slow or escalated progress and delays.
- Unusual material and equipment brought on or removed from the project when this is considered a significant effect in maintaining satisfactory progress.
- Documentation of actions taken and justification for these actions.
- Field sampling, testing and laboratory test results, particularly failures and resolution.
- When shutdown periods occur, the dates of work suspension and resumption and the reasons for the shutdown.
- Copies of the following items should be attached to the daily progress report:
 - Written instructions issued to the Contractor. (Written instructions must be authorized by the Construction Manager)
 - Written instructions/memos received from the Office.
 - Force account forms (when applicable).

Form: General Daily Progress Report

On permit jobs, inspectors should monitor their charged time and advise the Field Supervisor of any problems that may prevent the job from being completed within budget. Refer to the cost estimate worksheet items for inspection and material testing that is included in the front pages of the “blue book” permit folder.

BI-MONTHLY PAYMENT ESTIMATES

On contract projects, the Inspector prepares bi-monthly payment estimates of materials furnished and work performed as a basis for payment to the Contractor.

The City and the Contractor determine the month end and mid-month cutoff date at the preconstruction meeting. The Project Technician furnishes an inspector’s worksheet to the Inspector before the cutoff date. If the Inspector does not receive the worksheet, they should ask the Technician for it. The Inspector must turn in all installation sheets within 3 business days of the cutoff date.

On large projects, a sheet-by-sheet breakdown of the quantities in the bid is furnished

and should be use as a guide. In filling out the installation sheet for lump sum breakdowns, the Inspector should remember that it is an estimate and does not need to be detailed down to the nearest 0.10 cubic yard. The Contractor must sign the estimate before it can be processed.

An example of an inspector's worksheet and installation sheet is included in this section.

On permit projects, the City is not responsible for payment, and the Inspector defers payment questions to the Contractor or developer or his designee.

Form: Inspector's worksheet and Installation sheet

LOGGING AND FILING PHOTOGRAPHS AND VIDEOS

Section 6 describes the use of photographs and videos to document jobsite conditions.

All photographs must be indexed and filed in the project folder they should be logged in within a week (and no later than 3 weeks) of being taken. Videos should be submitted to the Project Technician for logging.

OTHER DOCUMENTATION

Examples of the following documents are included in this section. Subjects that are discussed in another section of this manual are cross-referenced to the appropriate section.

- Construction Authorization--letter and form

Additional Work Request (for L.I.D. projects)

Weekly Statement of Contract Time Charges

Based on information reported by the Inspector and reviewed by the Manager, this form is mailed to the Contractor to inform them of the number of days charged and days remaining on the contract. The Inspector is not involved in filling out this form, but should be aware of its use.

- Punch List
- As-Built Record Drawing

Information about employee procedures (time and attendance reports, vacation and sick leave, etc.) and examples of filled-out forms are contained in Appendix E.

END OF SECTION 15

NOTES

Construction Activity Continued		Project No.: 0	
2. Utility Work:			
3. Potential Problems:			
4. Verbal Instructions:			
5. Phone messages:			
6. Comments/Complaints From Residents:			
7. Visitors to Project:			
Prepared By: Inspector / Engineer		Work Date:	



INSTALLATION SHEET



Progress Payment No. _____

PROJECT: _____ CONTRACT No. _____ PROJECT No.: _____

ITEM DESCRIPTION: _____ ITEM No.: _____

LOC. / STA.: _____ LT. / C / RT. _____

PLAN SHEET # _____ NOTE # _____ ☐ NOT ON PLANS:

QUANTITY DATA

DATE INSTALLED: _____ METHOD OF MEASURE: _____

PREVIOUS QUANTITY: _____ UNIT: _____ (i.e. Taped, Wheeled, Count, LS)

INSTALLED THIS NOTE: _____ UNIT: _____ IS BID ITEM COMPLETE ?

TOTAL TO DATE: _____ UNIT: _____ ☒ YES ☐ NO

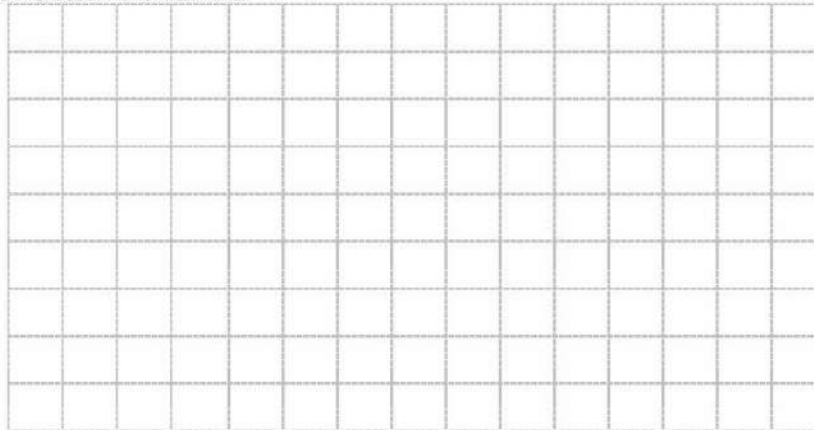
METHOD OF QUALITY ASSURANCE

- | | | |
|---|---|---|
| <input type="checkbox"/> F - FIR | <input type="checkbox"/> BLUE & GREEN SHEETS (elec.) | <input type="checkbox"/> VISUAL ACCEPTANCE |
| <input type="checkbox"/> O - CMO | <input type="checkbox"/> AASHTO/ASTM SPEC. No. _____ | <input type="checkbox"/> HEAT, LOT OR BATCH No. _____ |
| <input type="checkbox"/> Q - COMPLIANCE CERTS | <input type="checkbox"/> QPL APPROVED / QPL QUALIFIED | <input type="checkbox"/> L - ODOT LAB. REPORT # _____ |
| <input type="checkbox"/> E - EQUIP. LIST & DWG. | <input type="checkbox"/> WARRANTY | <input type="checkbox"/> SMALL QUANTITY ACCEPTANCE |
| <input type="checkbox"/> T - TEST CERTS | <input type="checkbox"/> FIELD TESTED | <input type="checkbox"/> BUILT AS PER PLANS AND SPECIFICATION |

SEE REMARKS BELOW OR ON BACK:
SKETCH / CALCULATIONS / REMARKS:

☐ UPDATED AS CONSTRUCTED PLANS

DATE UPDATED: _____



☐ SEE ATTACHED

☐ SEE BACK

INSPECTOR SIGNATURE _____

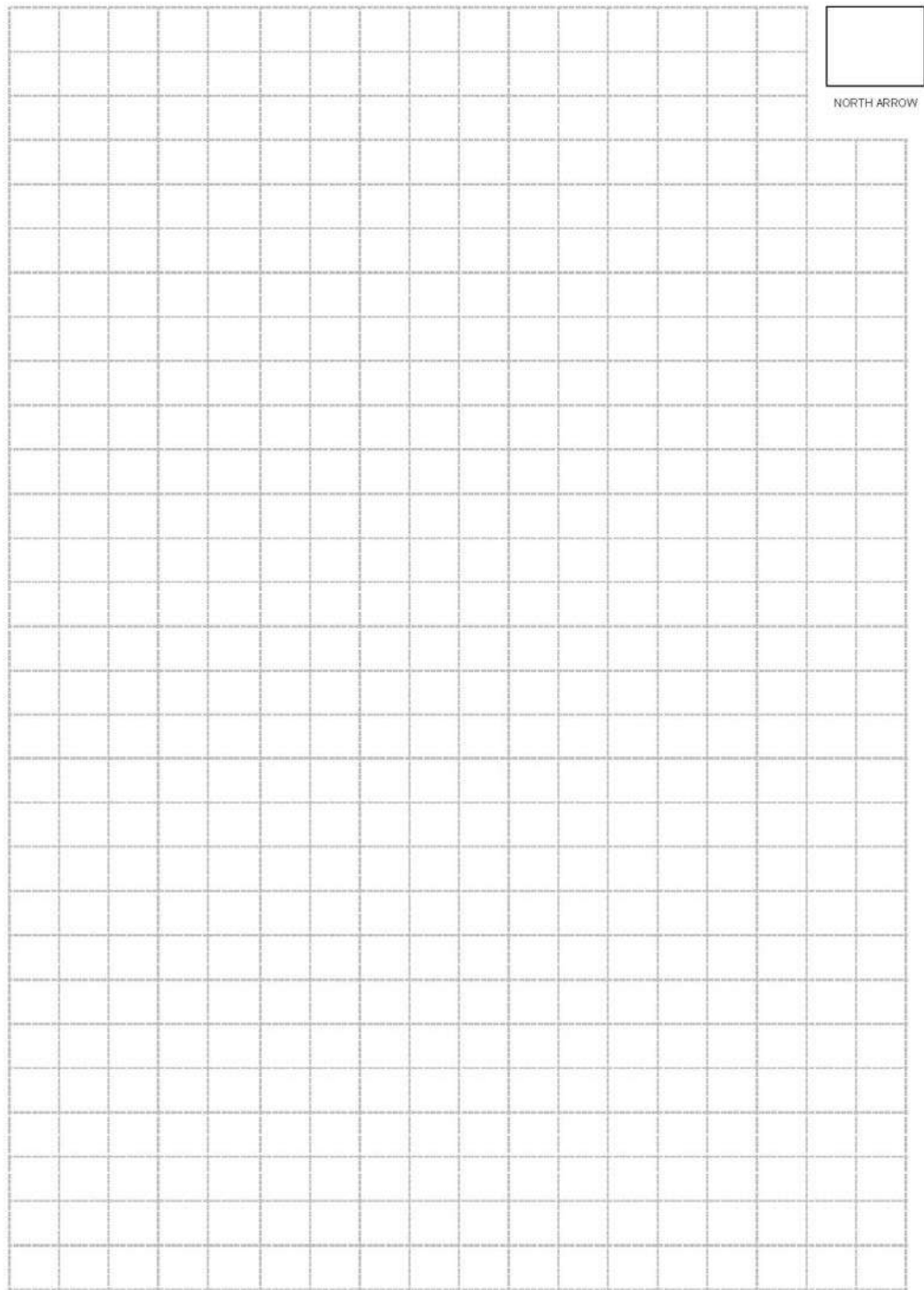
DATE _____

FOR OFFICE USE ONLY

☐ QUANTITY CHECKED ☐ QUALITY CHECKED

CHECKED BY: _____ DATE: _____

QUANTITY THIS NOTE: _____ UNIT: _____ ESTIMATE # _____ NOTE # _____





MATERIALS ON HAND CHECKLIST / PAY DOCUMENT



PROJECT: _____

CONTRACT: _____ PROJECT: _____ ITEM NUMBER: _____

☐ REQUEST LETTER FROM PRIME CONTRACTOR (REQUIRED FOR PAYMENT)

☐ ITEMIZED INVOICE (REQUIRED FOR PAYMENT)

ASSIGNED TO: _____ DATE: _____
(INSPECTOR)

SUPPLIER: _____ INVOICE #: _____

TYPE(S) OF MATERIAL: _____ ITEM #'S: _____

MATERIAL ON PROJECT ? ☐ YES ☐ NO IF NO, WHERE ? _____

☐ PERMIT OF ENTRY (REQUIRED FOR PAYMENT)

ACCEPTABLY STORED ? ☐ YES ☐ NO

METHOD OF QUALITY ASSURANCE		
SUPPORTING DATA		
<input type="checkbox"/> VISUAL ACCEPTANCE	<input type="checkbox"/> Q - COMPLIANCE CERTS	<input type="checkbox"/> FIELD TESTED
<input type="checkbox"/> O - CMO	<input type="checkbox"/> E - EQUIP. LIST & DWG.	<input type="checkbox"/> QI - COMPL. CERT W/MAT. # _____
<input type="checkbox"/> F - FIR # _____	<input type="checkbox"/> T - TEST RESULT CERTS	<input type="checkbox"/> L - ODOT LAB. REPORT # _____
<input type="checkbox"/> NO QUALITY DOCUMENTATION REQUIRED	<input type="checkbox"/> QPL APPROVED _____	<input type="checkbox"/> SMALL QUANTITY ACCEPTANCE
		<input type="checkbox"/> QPL QUALIFIED

OTHER: ☐ FIELD TESTS ☐ CUT SHEETS ☐ SHOP DRAWINGS


CMO FOR STEEL / IRON MATERIALS ? ☐ YES ☐ NO

(IF FEDERALLY FUNDED, REQUIRED FOR PAYMENT)


QUANTITY ACCEPTED: _____

INSPECTOR SIGNATURE _____ DATE _____ ☐ SEE BACK

FOR OFFICE USE ONLY	
<input type="checkbox"/> QUANTITY CHECKED	<input type="checkbox"/> QUALITY CHECKED
CHECKED BY: _____	DATE: _____
QUANTITY THIS NOTE: _____	ESTIMATE # _____ NOTE # _____

		FIELD INSPECTION CONTRACT NO. _____ BID ITEM NO. _____	
QUANTITY DELIVERED		QUANTITY ACCEPTED	
QUANTITY REJECTED		QUANTITY REJECTED	
VERIFIED ON MATERIALS	<input type="checkbox"/> HEAT, LOT OR BATCH NO.	<input type="checkbox"/> ASSHTOASTM SPEC. NO.	<input type="checkbox"/> CPL
SUPPORT DATA	<input type="checkbox"/> TEST RESULT CERTIFICATE	<input type="checkbox"/> QUALITY COMPL. CERTIFICATE	<input type="checkbox"/> EQUIP. LIST & DRAWINGS
INSPECTED BY	DATE		
REMARKS			

REV (06/2008)			

		FIELD INSPECTION CONTRACT NO. _____ BID ITEM NO. _____	
QUANTITY DELIVERED		QUANTITY ACCEPTED	
QUANTITY REJECTED		QUANTITY REJECTED	
VERIFIED ON MATERIALS	<input type="checkbox"/> HEAT, LOT OR BATCH NO.	<input type="checkbox"/> ASSHTOASTM SPEC. NO.	<input type="checkbox"/> CPL
SUPPORT DATA	<input type="checkbox"/> TEST RESULT CERTIFICATE	<input type="checkbox"/> QUALITY COMPL. CERTIFICATE	<input type="checkbox"/> EQUIP. LIST & DRAWINGS
INSPECTED BY	DATE		
REMARKS			

REV (06/2008)			



CONSTRUCTION ADMINISTRATION QC PLAN



Date: _____

SECTION: _____	CONTRACT NUMBER: _____		
CONTRACTOR: _____	FAP NUMBER: _____		
CONSTRUCTION MANAGER: _____	ODOT CPMLIAISON: _____		
RESOURCES:	CONSTRUCTION MANUAL <input type="checkbox"/>	FIELD TEST PROCEDURES MANUAL <input type="checkbox"/>	QCCS MANUAL <input type="checkbox"/>
	NONFIELD TESTED MATERIALS ACCEPTANCE GUIDE <input type="checkbox"/>	CONSTRUCTION PRODUCTS LIST <input type="checkbox"/>	INSPECTOR'S MANUAL <input type="checkbox"/>
PRIOR TO PROJECT START			
	REVIEW PLANS AND SPECIAL PROVISIONS: _____		
	REVIEW QUANTITIES AND LUMP SUM BREAK-DOWNS: _____		
	PREPARE NON- FIELD TESTED TEST SUMMARY: _____		
	PREPARE FIELD TESTED TEST SUMMARY: _____		
	PRE-CONSTRUCTION CONFERENCE (Lump Sum Breakdowns, Erosion Control Plan, Hazmat)		
DURING PROJECT	PRIMARY INSPECTOR: _____		
INSPECTION:	OTHER INSPECTOR: _____		
MATERIALS TESTING:	QCS: _____		
	PROCESS ALL MIX DESIGNS: _____		
	REVIEW TEST DOCUMENTS: _____		
	COORDINATE WITH CITY QA FOR I/A VERIFICATION TESTING: _____		
OFFICE:	PREPARE TEST SCHEDULES / SUMMARY: _____		
	VERIFIED BY: _____		
	PROJECT CLOSEOUT: _____		
	UPDATE "AS CONSTRUCTED": _____		
	POST NON-FIELD-TESTED QUALITY DOCUMENTS ON TEST SUMMARY: _____		
	POST FIELD-TESTED QUALITY DOCUMENTS ON TEST SUMMARY: _____		
	PREPARE FOREIGN STEEL SUMMARY, FMC, FMRR: _____		
	PREPARE STATSPEC: _____		
	CHECK STATSPEC: _____		
	CALCULATE ADJUSTMENTS: _____		
	CALCULATE QUANTITIES: _____		
	CHECK & POST QUANTITIES: _____		
	BACKCHECK PAYNOTE CORRECTIONS: _____		
	CHECK EWO INVOICES: _____		
	PROCESS ESTIMATE: _____		
	CHECK AND POST PAYROLL, EEO, OJT, EMPLOYEE INTERVIEW REPORTS: _____		
	PROCESS CONTRACTOR'S SUBMITTALS: _____		
	REVIEW SHOP DRAWINGS: _____		
	PROCESS SUBCONTRACTS: _____		
	TYPING AND FILING GENERAL PROJECT DOCUMENTS: _____		
	TYPING AND DISTRIBUTING COPIES OF CCO, EWO, ETC. _____		
	PREPARE GRADES AND COORDINATE INFORMATION: _____		
AT PROJECT COMPLETION	SEMIFINAL COORDINATOR: _____		
	NARRATIVE REPORT: _____		
	STATUS OF SFOS: _____		
	"AS CONSTRUCTED" SIGNED, DISTRIBUTED: _____		
	DAILY REPORT AND P.M. DIARY ORGANIZATION: _____		
	PREPARE PROJECT PHOTOGRAPHY: _____		
	LABOR COMPLIANCE, PAYROLL, INTERVIEW REPORT ORGANIZATION: _____		
	QUANTITY REVIEW AND ORGANIZATION: _____		
	NON-FIELD TESTED TEST SUMMARY REVIEW AND ORGANIZATION: _____		
	FIELD-TESTED TEST SUMMARY REVIEW AND ORGANIZATION: _____		

CAP new report.xls



BUREAU OF TRANSPORTATION ENGINEERING

*** PUNCH LIST ***

May 9, 2008

Permit Name: NE Ivy St / Cook St / MLK
PDOT Permit No.: 43602
BES Permit No.: NA
Account Code: 452

Permittee: J & A Investment, LLC
Contractor: Tapio Construction

When the following items have been corrected on this project, it will be complete and acceptable to the Permit Engineering Section, Development Services Division and the Construction Inspection Section, Engineering Services Division.

CONTRACTOR WORK ITEMS

1. Backfill edge and back of sidewalk flush with top of walk.
2. Remove construction debris.
3. Install bark dust in tree wells, or retrieve tree grates from Maintenance Bureau.
Contact Jim Buhler at 823-8362
4. Remove lip around street lighting power box.

Corrections listed above have been completed by the contractor and I accept this job as complete

Signature
_____, City Inspector
Print Name

Date

Street Lighting – Norberto Adre (503)823-5176

5. Install PE cell
6. Replace R-Type fuse with standard KTK (all poles)
7. Plug conduits in J-Boxes
8. Grout under all poles & panel
9. Paint poles
10. Caulk #12 casting
11. Seven day system test
12. "As Built"
13. Change out 1 J-Box lid to indicate signal vs. lighting @ north end of project—looks like existing interconnect.

Corrections listed above have been completed by the contractor and I accept this job as complete

Signature
_____, City Inspector
Print Name

Date



City Forester – Joe Hintz (503) 823-4025

14. Inspect Street Trees.

Corrections listed above have been completed by the contractor and I accept this job as complete

Signature

Date

_____, City Inspector

Print Name

Permit Fee

15. Permit Fee. It appears that the cost for the permit will come close to the estimate. No additional deposits are needed at this time. Final accounting will be done at closing.

CITY WORK ITEMS

Traffic Signs – Wendy Cawley (503) 823-4396

1. Install crosswalk bar.
2. Install striping.

Parking Control Signs – Ramon Corona (503) 823-5226

3. Install parking controls as required.

All the requirements of this project have been completed by the permittee, and I accept this job as complete.

Chon Wong, Permit Engineering
(503) 823-7050

Date:

APPENDIX A - INSPECTOR'S EQUIPMENT

CELLULAR PHONES

Inspectors have cellular phones. The Inspector will be asked to sign a cellular phone usage form.

TOOLS

The Inspector should have the following tools in his vehicle:

- 12-foot engineer's tape
- 25-foot engineer's tape
- 50-foot engineer's tape
- Smart level
- Hand level
- Wooden rule
- String line
- Asphalt thermometer
- Air thermometer
- White spray paint
- Yellow keel
- Manhole hook
- Flashlight
- Mirror
- Gloves
- Camera
- Calculator
- Pocket scale
- Hardhat
- Safety vest
- Safety glasses
- Shovel
- Rake
- Appointment calendar

Forms:

- Daily progress report forms
- Other documentation forms as needed (*e.g., construction authorization forms, additional work requests - See Section 15*)

APPENDIX B - NOISE

Contractors must comply with construction noise regulations as established in Title 18 (Section 18.10.060) of the City Code and summarized below. The Inspector should be familiar with these regulations and monitor the Contractor for compliance.

7 A.M. - 6 P.M. MONDAY THROUGH SATURDAY

Noise levels are restricted to 85dBA at a 50-foot distance. Most equipment that is in good repair and muffled (where possible) will comply with this level. The few kinds of equipment that cannot meet this standard (*e.g., jack hammers, concrete saws, and pile drivers*) are exempt from the 85dBA limit during this period.

OTHER HOURS

Reduced limits apply at night (5 p.m. to 7 a.m.) and weekends (6 p.m. Saturday to 7 a.m. Monday). Work at these hours must conform to the "noise needs" of the area in which the work occurs. This means that there will probably not be problems with work in an industrial zone; however, work such as clearing, grading, or excavating in a residential zone or near residential use will probably be in violation.

It should be remembered that the restrictions before 7 a.m. also apply to warm up and maintenance noise.

The exemptions allowed for jack hammers and other noisy equipment during working hours on Monday through Saturday do not extend to other hours, and such equipment cannot be used.

EXCEPTIONS

The noise regulations do not apply during an emergency (defined as "work made necessary to restore property to a safe condition following a public calamity, work to restore public utilities, or work required to protect persons or property from imminent exposure to danger").

There may also be other reasons for works outside of the usual hours. Contractors may apply for construction noise variances, which may be issued if the need is valid and the impacts on people are not great.

Any questions about construction noise regulations should be directed to the City's Noise Control Office at 503-823-7350.

APPENDIX C - SAFETY, ACCESS, AND TRAFFIC CONTROL

Although the matter of safety at the jobsite is the Contractor's legal responsibility, the Inspector should encourage safe working practices by pointing out possible sources of danger. If the Inspector believes the Contractor's measures to provide job or public safety are inadequate, they must inform the Contractor to take additional precautions. If the Contractor fails to take remedial action on safety violations, the Inspector should notify the Field Supervisor or Manager.

INSPECTORS

Safety regulations can reduce risk, but never eliminate it. A construction site is essentially a dangerous place, and the Inspector must think and act accordingly. Their personal safety is their responsibility. The following precautions should be taken:

- Remain alert at all times.
- Wear a safety helmet and safe footwear.
- Wear a safety vest.
- Make sure that you can see and be seen.
- In case of an emergency, the Inspector should call 911.

WORKERS

Workers safety is governed by Occupation Safety and Health Administration (OSHA) safety rules and regulations. The Inspector should be familiar with the regulations that apply to construction work. A copy of the OSHA regulations is available in the Office for reference.

TRAFFIC SAFETY AND ACCESS

00170.60

The Contractor must conduct construction operations in a manner that causes the least possible obstruction and inconvenience to the public and protects pedestrian and vehicular traffic.

The Contractor is usually required to submit a traffic control plan to the Bureau of Traffic Safety Management (BTSM) before construction begins. It includes provisions for installing and maintaining necessary signs, barricades, lighting, street closures, and detours throughout the project. After approval by BTSM, the plan is included in the construction documents.

Whether or not a traffic plan is included in the construction documents, the Contractor is responsible for providing traffic control devices in conformance with the Manual on Uniform Traffic Control Devices (MUTCD). It is the Inspector's job to ensure that the Contractor meets these requirements and to inform the Contractor of any unsafe or inadequate practice or condition.

Exhibit C-1 is an example of how traffic control devices are typically applied. Traffic control manuals are available in the Office for further reference if needed.

The following list summarizes the proper safety, access, and traffic control measures that should be provided by the Contractor and checked by the Inspector.

- Install and maintain all necessary signs, barricades, lights, and other traffic control devices.
- Provide necessary flag persons.
- Provide open trenches and excavations with secured and adequate barriers or fences at all times.
- Close up or plate all open excavations at the end of each working day (unless otherwise approved by the Manager) in all street areas and other areas where it is reasonably required for public safety.
- Place "No Parking" signs where appropriate (where vehicular parking is a hazard to through traffic or to the work).
- Illuminate all detours and obstructions with flashing barricades during hours of darkness.
- Provide reasonable access at all times for emergency traffic such as police, fire, and disaster units.
- Maintain access to fire hydrants and water valves.
- Provide required access to residents. The Contractor can deny access to properties during working hours (except for emergency vehicles); must provide access to the front of the property (but not into the driveway or garage) after working hours.
- Provide temporary walks and bridges for pedestrians where required.
- Separate pedestrians from traffic and other hazards.
- Maintain pedestrian access to businesses.

Occasionally, it will be necessary for a street to be closed during construction. The Contractor should notify appropriate police, fire, and school authorities of street closures as soon as they know the closure is necessary, giving as much prior notification as possible. If they are unable to do this they should inform the Office so they can provide notification.

APPENDIX D - LANDSCAPING AND TREES

Removal of trees or damage to trees is a very sensitive issue in the City of Portland. It can be expensive to resolve claims for wrongful damage. All questions about trees should be referred to the City Forestry Division of the Bureau of Parks and Recreation.

It is important that the Inspector understand responsibilities and procedures for street construction around existing trees and tree removal. They should not make any decisions regarding trees, even if they feel qualified.

The existing policy for street construction Inspectors follows. More information is contained in the "Street Tree Protection Procedures" included at the end of this appendix.

- The City Forester or representatives are the only people authorized to determine if trees or shrubs are to be removed. If trees are to remain, the Forester determines if the design will harm them and works with the project manager to reach agreement on the design. The Inspector should inform the Contractor of any tree requirements and notify the Forester of any problems.
- Root exploration will be done prior to construction on all questionable trees. A street construction Inspector, the City Forester, and a representative from the Design section should be present when the Contractor performs the root exploration. Any necessary root pruning or cutting will be made at this time, as directed by the City Forester. Decisions regarding removal of trees should be made only by the City Forester.

An example of the tree/shrub removal authorization form is included at the end of this appendix for the Inspector's information only. The Construction Manager is responsible for completing this form.

Landscape and Irrigation

All work within the right-of-way requires a permit. If landscaping and irrigation are not on the street plans, a separate ordinance and permit is required from the Street Systems Management Section. The Forester must approve tree species and spacing. If landscaping is on the street plans, it is jointly inspected by streets and parks inspectors.

STREET TREE PROTECTION PROCEDURES

City-Contracted and In-House Designed Permit Street Improvements:

The following procedures shall apply to all Bureau sections that manage street improvements constructed either by City contract or by the Bureau of maintenance. More specifically, these procedures are to be followed for Arterial, LID, HCD and all interagency street improvements.

1. Design surveys shall identify the size (diameter at 4.5 feet above ground surface, whether the tree is coniferous or deciduous, and locations of all trees to a distance of 15 feet outside the street right-of-way.
2. Following the preparation of base maps and prior to any design, the project manager shall walk the project with the City Forester or designee to verify species and general condition, to identify the appropriateness of specific trees, and to identify potential conflicts and other problems. The City Forester and project manager shall indicate on a copy of the base maps the closest locations that curbs, driveways and sidewalks can be placed and still save desirable trees. The project manager shall document the inspection in the project files.
3. The project manager shall photograph all trees recommended by the City Forester to be saved or removed.
4. Street alignment and grades shall be set so as to make reasonable accommodation of those trees recommended by the City Forester to be saved.
5. The project manager shall provide plan sheets to the City Forester for review and comments. This review shall include another joint field review by the project manager and City Forester, if deemed necessary by the City Forester or project manager, to consider the impact of the proposed street on desirable street trees. The City Forester shall recommend any necessary exploratory root excavation and provide a report on the inspection. The City Forester shall document comments made during the inspection and provide a written report to the project manager. In those cases where no trees are affected by the proposed street improvement, the City Forester shall initial the preliminary plans as having been reviewed, and return the plans to the project manager.
6. The project managers shall meet with or provide written notification to all property owners whose trees may have to be removed or severely trimmed. The purpose of the meeting or written notification is to inform property owners of the effects of the street improvements on trees fronting on their property. Each meeting or letter shall be documented in the project files. The City Forester shall accompany the project manager on any meetings with property owners, if requested by the project manager or property owner.

7. The project manager shall request that property owner's sign the attached "NOTIFICATION OF TREE REMOVAL" forms prior to removing trees which are in obvious conflict with the proposed street improvement. If signatures cannot be obtained, the project manager shall document discussion with or written notification to the property owner in the project file. Property owners may also request the removal of trees by completing and signing the attached "REQUEST TO REMOVE TREE" form. In the case of property owner requests for tree removals, the final decision to remove any tree shall rest with the City Forester.
8. If a preliminary plan review meeting is held with property owners, the disposition of trees shall be discussed and appropriate forms signed by the property owner at that time.
9. In those cases where the City Forester is unable to assess the potential damage of street construction on roots of certain trees, the project manager shall contract for services to conduct exploratory root excavation. The project manager and City Forester shall be present during exploratory excavation. The City Forester shall direct the contractor on where and how deep to excavate.
10. Following exploratory root excavation and recommendations from the City Forester, the City Forester shall prepare a report of findings with recommendations, and the project manager shall modify the plans accordingly. The owners of property adjacent to trees recommended for removal as a result of the exploratory excavation shall be notified and asked to sign a "NOTIFICATIONS OF TREE REMOVAL" form.
11. Final plans and specifications which ensure that each tree affected by the improvement is specifically and clearly identified, and its disposition clearly noted (No ambiguous statements such as "save if possible.")
12. A copy of final plans shall be reviewed by the City Forester, who will acknowledge that all agreed upon changes have been made to the plans.
13. Following construction authorization, but prior to bidding, the City Forester shall order certain trees removed. Those trees within the street right-of-way which are in a serious state of decline, which pose a public hazard or which are not appropriate as street trees and which conflict with the proposed street or sidewalk alignment, shall be ordered removed by the City Forester, per 20.40.080(E) of the City Code, as part of the street improvement project cost. Trees on private property which pose a public hazard independent of any street construction activity shall be ordered removed by the City Forester at property owner expense.
14. During the pre-construction conference, all affected trees on the project shall be specifically discussed with the contractor, utilities and inspector. The City Forester shall be invited to the conference.

15. All trees to be removed shall be spray-painted with a red X on the trunk. The project manager, inspector, City Forester and contractor shall walk the project to make sure all affected parties are informed of the proposed treatment of trees.
16. The inspector shall arrange for the City Forester and the project manager to be present on the construction site whenever construction activities threaten any trees that are to be protected.
17. If roots are torn or cut without prior approval, the City Forester shall inspect the damage and determine the final disposition of the tree. The project manager shall ask the adjacent property owner to sign a "NOTIFICATION OF TREE REMOVAL" form for trees that the City Forester determines need to be removed. If the property owner refuses to sign the notification form, the project manager shall document discussions with the property owner in the project file. The City Forester shall then order the project manager to have the Contractor remove the tree.

Consultant Designed Permit Street Improvements:

For street improvement projects with construction plans prepared by a private engineering consultant, the following procedures shall be observed.

Design Phase - General Case (all trees within development site)

1. Design surveys shall identify the size (diameter at 4.5 feet above ground surface), whether the tree is coniferous or deciduous, and locations of all trees within an impact zone that shall include the street right-of-way. This information shall be shown on the plans.
2. Prior to submittal of the construction drawings for approval, the design engineer shall contact the City Forester to resolve the disposition of all trees in the project area. The construction plan shall clearly indicate SAVE or REMOVE all trees within the impact zone.
3. During the initial plan check, the plan review engineer shall provide the City Forester with a set of field check plans, and request the City Forester to review the proposed work site and prepare a written report identifying the potential impact on the trees by the proposed project. The City Forester may suggest design changes and/or construction practices that will protect the trees. The City Forester's report will be provided to the plan review engineer, who will forward the report to the design engineer for action. The Forester recommends maintaining a minimum 25' separation between trees and streetlights.
4. Exploratory root investigation may be ordered by the City Forester at permittees expense in those cases where the disposition of trees cannot be determined from surface inspection.

AUTHORIZATION TO REMOVE TREE(S) OR SHRUB(S)

I/We the undersigned, being the owner(s) of the property described as:

Address _____

Lot _____ Block _____ Addition _____

acknowledge that the _____
(Identify tree(s) or shrub(s) to be removed)

adjacent to/within the above-described property interferes with the proposed street improvement of:

(Project Name)

and authorize the Contractor to remove said tree(s) or shrub(s).

I/We understand that removal of said tree(s) or shrub(s) will be done at no cost to me/us. I/We further agree that I/We will not be compensated for removal of said tree(s) or shrub(s).

Name of Owner

Name of Owner

Signature of Owner

Date

Telephone

Signature of Owner

Date

Telephone

WITNESS: _____

APPROVED: _____
Design Engineer

Date

APPROVED: _____
City Forester

Date

APPENDIX E - EMPLOYEE PROCEDURES

TIME AND ATTENDANCE REPORTING

Scheduled work hours are 7:00am-3:30pm. It is strongly recommended that your timesheet entries are completed on a daily basis, at a minimum of once per week. Your timesheet must indicate if you want any overtime worked to be paid time or comp time.

OVERTIME REPORT

Overtime that is an extension of normal schedule you must enter (7:00am-6:00pm would be entered labor regular 7:00am-3:30pm and labor overtime 3:30pm-6:00pm).

Hours that differ from schedule the timekeeper will have to be entered by the timekeeper; unless there is a schedule for projects that would require a different schedule for an extended period of time.

Submit a time request within SAP for overtime worked.

Overtime must be approved in **advance** by the Construction Manager and verified by the Field Supervisor.

VACATION AND SICK LEAVE

A request for Vacation/ Sick Leave must be filled out for vacation and sick leave. Vacation time should be requested as far in advance as possible. Sick leave reports should be submitted immediately after returning to work.

Because the summer construction season is the busiest time of the year for the Construction Inspection Section, the following policies apply to vacation time:

- Generally, no more than one Inspector can be on vacation at any one time between Memorial Day and Labor Day.
- Between Memorial Day and Labor Day, Inspectors are requested to limit vacation requests to a maximum of 5 consecutive workdays.
- All vacation requests will be granted on a first come, first served basis, and must be cleared in advance with the Field Supervisor. All requests for more than 2 days of summertime vacation should be submitted to the Field Supervisor by March 31. This will help ensure that employees receive their preferred time slots.

EMPLOYEE ASSISTANCE PROGRAM

The City of Portland offers its employees an employee assistance program (EAP) through Cascade Counseling Center. The EAP is designed to help employees with problems that are serious enough to affect their job performance or personal well-being. More information about the EAP can be obtained from the Manager or Officetimekeeper.

ACCIDENT REPORTS

Any automobile accident or loss should be reported immediately to the Field Supervisor. A completed accident report form must be submitted to the Field Supervisor within 24 hours.

All on-the-job injuries (City employees) must be reported to the Risk Management Division. An example of the "State of Oregon Worker's and Employer's Report of Occupational Injury or Disease" form is included at the back of this appendix.

The "Report of Vandalism, Theft, Loss, Intentional Destruction, or Abuse of City Property" form should be used to report theft, loss, or damage valued at \$25.00 or more. A copy of this form is included at the back of this appendix.

PARKING OF CITY-OWNED VEHICLES DOWNTOWN

The following procedures should be followed for parking City owned vehicles downtown.

Parking Meters

City cars may be parked at City parking meters for free, but the parking time is limited to the meter's maximum designated length of time. The employee who parked the car is responsible for paying any overtime parking tickets.

Other Downtown Parking

A number of vehicles are parked overnight at locations other than the Auto port. When employees using these cars come to the Office downtown, they should park at a meter that will cover the amount of time needed or on an hourly basis at one of the Smart Park garages. If possible, they should park at one of the Portland Public Parking garages, which are less expensive than the privately operated garages. Parking stubs should be brought to the Office for validation.

City owned vehicles should be locked at all times and locations so equipment will not be stolen.

APPENDIX F - COMMONLY ASKED QUESTIONS

Property owners sometimes ask the Inspector questions about areas that are not their direct responsibility, but are related to work. The following information may help address some of these questions or refer the property owner to the appropriate source of information.

- The property owner is responsible for sidewalk and driveway maintenance and repair; the City is responsible for curbs and corners. The Bureau of Maintenance routinely checks sidewalks for trip hazards and notifies property owners of needed repairs. BOM can give the property owner an estimate for doing the repairs, or the property owner can contract with a private contractor to do the work. BOM is responsible for inspecting the repairs.
- BOM is responsible for street, sewer, and inlet maintenance after the street has been constructed.
- On new subdivisions, the developer may sometimes defer installing sidewalks in front of building lots by providing covenants to the City. This allows later construction on the private property without the need to cross and protect new sidewalks. The builder is then required to construct the sidewalks before receiving occupancy permit.

There are a number of questions that Contractors commonly ask Inspectors. The following list shows typical subjects of these questions and gives the section and page number where the subject is addressed in the Standard Construction Specifications.

Subject	Section
Extra work and changes	00140.60
Authority of Inspectors	00150.02
Survey 3-day notice	00150.15
Use of improvement during construction	00406.43
Dust control	00280.10
Noise	00290.30
Removal of defective work	00110.20
Overtime work	00170.95
Permission to use private property	00170.03
2-year maintenance and warranty	00150.96
Owner's right to do work	00180.15
Payment for minor changes	00140.30

Subject	Section
Payment by force account	00197.10
Temporary traffic control	00225
Root cutting	01120.42
Trench work limits	00405.01
Embankment compaction	00330.42
Trench excavation and backfill pay width	00405.41c
Rock gradation	00641.10
Asphalt laydown temperature (air and surface)	00747.49
Curing of concrete	00756.53
Expansion and contraction joints	00759.48
Concrete mix designs	00756.13
Adding water to concrete	00756.46
Parabolic crown	Plan 3-159
Manhole first step maximum distance	Plan 4-06-1
Inlet maximum depth	Plan 4-30

GLOSSARY

This glossary includes selected terms that are contained in the manual and commonly used in the Inspector's work.

GENERAL TERMS

As-built Drawings: Construction drawings revised to show significant changes made during the construction process. As-built drawings should show any deviations from the original plans and should dimension any items where the plans leave it to the Inspector to establish limits.

Blue Book: See "Construction Documents."

Bi-Monthly Payment Estimate: Monthly estimates of materials furnished and work performed, made by the Inspector as a basis for payment to the Contractor (on contract improvements only).

Certificate of Completion: Acceptance of the final project after all punch list items are satisfactorily corrected. The completion date of all corrections as verified by the Inspector is the date of acceptance. A certificate of completion is then issued to the Contractor/permittee.

Change Order: A written order to the Contractor making changes in the materials, operations, time, or amount of work originally designated in the contract. Change orders take precedence over the original construction documents.

Construction Documents: The documents that govern the work to be done. They include the plans, street permit, special specifications, and bid price tabulation. On permit projects, these documents are bound and referred to as the "blue book."

Construction Inspection Section: The section within the City's Bureau of Transportation Engineering that is responsible for providing street inspection services for construction work performed in the public right-of-way.

Contract: The legally enforceable promise or agreement executed by the owner and the Contractor for the construction of the work.

Contract Improvements: The City designs the project, hires a qualified Contractor to do the work, and manages the project from start to finish.

Contractor: The person or organization responsible for performing the construction work and identified as such in the construction documents.

Field Supervisor: The Manager's "eyes and ears" in the field. He monitors all inspection

projects and keeps the Manager informed of their progress. The Field Supervisor trains new Inspectors and should be the Inspector's first contact for questions or problems (unless otherwise indicated in the manual).

Final Inspection: Inspection of a project when it is substantially complete to verify that the final project conforms to the project plans and specifications.

Final Punch List Inspection: Re-inspection of a project after punch list items have been corrected to ensure that all work has been satisfactorily completed.

Housing and Community Development Improvement (H.C.D.): A type of contract improvement that is subsidized by the federal government and targeted for urban renewal or depressed economic areas. Funding is a combination of federal grant money and L.I.D. funding.

Inspector: The street construction Inspector PBOT/CON Section. (Other types of inspectors involved in a project are defined in the manual.)

Local Improvement District Improvement (L.I.D.): A type of contract improvement where local citizens/neighborhoods can upgrade their residential streets to current urban standards. Property owners within the L.I.D. pay the City for the improvements after the project is complete.

Manager: The section Manager of the Construction Inspection Section. He manages the inspection of all street construction projects to ensure they are built to the project plans and specifications.

Office: The Construction Inspection Section office.

Permit Improvements: Street construction projects that are constructed in the public right-of-way under City permit. They are entirely paid for by the permittee (developer or property owner). The permittee designs the project, hires the Contractor, and manages the construction. The City approves the plans, issues the permit and construction documents, and inspects the construction work.

Permittee: The developer or property owner who has obtained a City permit for a street construction project (permit improvement) in the public right-of-way.

Project Manager: PBOT's Project Manager who is responsible for the design and/or permitting aspects of a project.

Punch List: A list of items identified during the final inspection as needing correction. The punch list includes any necessary repairs and any work that is not in strict conformance with the project plans and specifications.

Special Specifications: Specifications that are specific to a project and amend and supersede the Standard Construction Specifications.

Standard Construction Specifications: A document containing the City of Portland's standard specifications for construction within the City.

Standard Plans: Standard plans that are included in the Standard Construction Specifications.

Subcontractor: A person or organization that has a direct contract with a prime contractor to perform a portion of the work at the site.

Substantial completion: The stage when the project is capable of performing its intended function (i.e., is paved). At this stage, minor items such as signing and landscaping can be included on the punch list.

TECHNICAL TERMS

Apron: The portion of a concrete driveway that is between sidewalk (through ped zone) and curb.

Backfill: The material used to fill a trench.

Bedding: The material used to support a pipe.

Berm: The relatively flat dirt area behind the curb. Width is defined on the typical street section.

Driveway Connection: The portion of a driveway that connects the driveway apron to private property. This can be gravel, asphalt, or concrete.

Dropped Curb: A method for curb construction. The curbs of driveways and wheelchair ramps are built during the curb construction by depressing the concrete in the forms. **This method is not allowed.**

Dropped Connection: A method of connecting pipe to a manhole with a portion of pipe installed vertically either inside or outside of the manhole.

Embankment: Commonly called fill.

Slump: A standard method of defining the "wetness" of concrete by measuring how much it settles when a filled cone is slowly removed (i.e., 1 inch is very stiff and 8 inches is soupy).

Subgrade: The earth portion of a street prior to placing the base and pavement.

Throat (Lip): The portion of a concrete driveway that is nominally 1 inch above the gutter.

Utility Drop: The small wires that serve individual houses from utility poles.

Wing: The tapered portion of concrete curb on driveways and wheelchair ramps. (See Standard Plans for length.)

